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BECKWITH (C. S.). [Notes on Work with Cranberry Insects in 1940.]—*Proc. Amer. Cranb. Gr. Ass.* **71** pp. 12, 13, 16, 17. 1940. (Abstr. in *Exp. Sta. Rec.* **84** no. 4 p. 495. Washington, D.C., 1941.)

Studies have shown that the tipworm [*Dasyneura vaccinii*, Smith] has two generations a year in New Jersey, one being active in early June and the other in early July. The larva overwinters in a cocoon attached to a fallen leaf or stem and is not affected by the winter flood. In a cage that covered 16 sq. ft. of surface on an infested cranberry bog, 55 flies of the overwintered generation emerged between 23rd May and 4th June, and a few adults of the next generation between 13th June and 2nd July. The females apparently began to oviposit when they were less than three days old. It was found during the year that the egg stage lasted 24–48 hours, and that the larva fed on one leaf before moving to one of the tips, and that feeding on the tip leaves in the open probably lasted at least two days.

MOXON (A. L.). **The Selenium Content of Grasshoppers found feeding on Seleniferous Vegetation.**—*Proc. S. Dak. Acad. Sci.* **19** pp. 69–70. 1939. (Abstr. in *Exp. Sta. Rec.* **84** no. 4 p. 499. Washington, D.C., 1941.)

Infestations by grasshoppers have been severe in both seleniferous and non-seleniferous areas of South Dakota during the past few years. Investigations, a report of which is given, indicate that there is a direct correlation between the selenium content of the grasshoppers and that of the vegetation upon which they have fed. Since selenium is rendered non-toxic by arsenic and arsenic is rendered more or less non-toxic by selenium, the effectiveness of arsenic as a poison for grasshoppers in seleniferous areas is questionable.

MUNRO (J. A.) & BUTCHER (F. G.). **Say's Stinkbug.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **3** no. 2 pp. 11–13, 1 fig. 1940. (Abstr. in *Exp. Sta. Rec.* **84** no. 4 p. 499. Washington, D.C., 1941.)

Say's stinkbug [*Chlorochroa sayi*, Stål] has considerably increased in abundance in North Dakota during the past few years. In 1940, an outbreak resulted in severe injury to more than 10,000 acres of wheat in one south-western county, while damage in many fields was so high that the grain was not worth harvesting. Considerable injury was also caused to flax. So far, no satisfactory methods have been developed for complete control of this Pentatomid, but cultural practices, including the burning of weeds and rubbish, ploughing infested stubble during summer, and the working of stubble fields shortly after harvest, are recommended.

BARBER (H. S.). **Some Fleabeetles injurious to Beans in tropical America (Genus *Diphaulaca*, Family Chrysomelidae).**—*Proc. ent. Soc. Wash.* **43** no. 3 pp. 65–68. Washington, D.C., 1941.

Flea-beetles found in aeroplanes arriving in Texas from the south represent a species that seriously injures beans in Mexico but has not yet been recorded from the United States. It has long been known as *Diphaulaca aulica*, Ol., but differs from that species in the shape of the aedeagus, though it belongs to the genus *Diphaulaca* as restricted in this paper.

As a result of examinations of specimens in the United States National Museum, the author proposes the new genera *Diphaltica* and *Hornaltica* for *Diphaulaca nitida*, Jac., and *D. bicolorata*, Horn, respectively, and recognises five species of *Diphaulaca*, all of which are thought to attack leguminous plants. Characters distinguishing these genera and species are given in a key. The species of *Diphaulaca* are *D. wagneri*, Har., from Guatemala and possibly Mexico, *D. aulica*, from French Guiana, *D. meridae*, sp. n., from Venezuela and Trinidad, and *D. cordobae*, sp. n., and *D. panamae*, sp. n., which are recorded on beans, the former in Mexico and the latter in Panama and Colombia. Notes are given on three species of doubtful identity not included in the key. They include *D. volkameriae*, F., which is probably a West Indian species, and *D. striata*, Klug, which is possibly the pest of beans in Brazil recorded as *D. volkameriae* [R.A.E., A 21 664].

MCGREGOR (E. A.). **The Avocado Mite of California, a new Species.**—*Proc. ent. Soc. Wash.* 43 no. 4 pp. 85–88, 12 figs., 1 ref. Washington, D.C., 1941.

A mite that has been known to attack avocado in California for more than ten years has been misidentified as *Paratetranychus yothersi*, McG. [cf. R.A.E., A 24 251], which is a pest of avocado and other trees in Florida, but comparison of the male genitalia showed it to be a distinct species, and it is here described from adults of both sexes as *P. coiti*, sp. n. Characters by which it may be distinguished from three closely related species, *P. (Oligonychus) major*, Ewing, *P. ununguis*, Jac., and *P. ilicis*, McG., are also given. The life-cycle lasted seven days at a constant temperature of 77°F. under laboratory conditions, but at 91.4° no development occurred and all stages died.

MONTE (O.). **Dois percevejos prejudiciais às laranjas.** [Two Bugs harmful to Orange.]—*Biologico* 7 no. 7 pp. 187–191, 2 figs., 4 refs. São Paulo, 1941.

The Coreids, *Leptoglossus gonagra*, F., and *Phthia lunata*, F., the adults of which are briefly described, injure orange fruits in a district in the State of Parana that adjoins São Paulo, where there are important plantations of *Citrus*. *L. gonagra* is well known, but *P. lunata* has not previously been recorded as a pest in Brazil, and little is known of its alternative food-plants. If no fruits are available, the nymphs and adults of these Coreids feed on the young shoots, which wither. The feeding punctures in the fruits cause them to decay internally and fall. The eggs are laid on twigs near the fruits. Reduviid bugs observed among the nymphs were certainly predacious on them. The only method of control available is hand-collection, but the bugs are active and difficult to catch. Alternative food-plants should be destroyed.

FALANGHE (O.) & BITANCOURT (A. A.). **A infestação de cochonilhas nas frutas e as pulverisações das laranjeiras.** [The Infestation of Fruit by Coccids and the Spraying of Orange Trees.]—*Biologico* 7 no. 7 pp. 192–193, 1 diagr. São Paulo, 1941.

Observations in São Paulo on 2,280 sweet orange trees that had been sprayed with 1 per cent. Bordeaux mixture, lime-sulphur (1 : 40)

or a 2 per cent. mineral-oil emulsion, showed that the oil was very effective against the Coccids, *Lepidosaphes beckii*, Newm. (*pinnaeformis*, auct.), *Pinnaspis aspidistrae*, Sign., and *Chrysomphalus ficus*, Ashm. (*aonidium*, auct.). Examination of samples of the fruit showed that of those sprayed with it, about 73 per cent. were uninfested and the remainder lightly infested; following lime-sulphur, about 4 per cent. were uninfested and 80 per cent. lightly infested, while the remainder showed medium infestation, and following Bordeaux mixture, the percentages of light, medium and heavy infestation were about 44, 38 and 18. On unsprayed trees, about 20 per cent. of the fruits were uninfested, and 76 and 4 per cent. showed light and medium infestation, respectively.

PICKLES (A.). **Observations on some of the less familiar Pests of Citrus in Trinidad.**—*Proc. agric. Soc. Trin. Tob.* **41** pt. 1 pp. 395-397, 399, 1 fig. Port-of-Spain, 1941.

This is the first paper of a proposed series on pests of *Citrus* in Trinidad and comprises a brief description of the adult and larva of *Cratosomus punctulatus*, Gylh., with notes on its bionomics and control. This weevil attacks various plants, including all species of *Citrus*, and though infestation by it is usually localised, it may kill many trees within the affected area. The eggs are usually laid singly in a crack of the bark on a small branch, and the newly hatched larvae bore immediately into the wood. As the larvae grow, they tunnel down into the larger branches and subsequently into the main trunk and larger roots. They pupate in their tunnels, and the adults appear to remain in them for the greater part of their lives. The period of development probably lasts at least a year. The smaller branches are rapidly killed by the boring, and some or all of the remaining branches are killed when the larva reaches the roots. The trees should be inspected regularly, and dead or dying branches removed as soon as they are noticed; if they contain a central tunnel, the tree should be cut back until the end of the tunnel is found and the insect destroyed.

VAN ZWALUWENBURG (R. H.). **Canton Island.**—*Hawaii. Plant. Rec.* **45** no. 1 pp. 15-24, 9 figs., 2 refs. Honolulu, 1941.

Since aircraft of the Pan American Airways Company operating between Hawaii and New Zealand call at Canton Island, a coral atoll about 1,670 miles from Honolulu, the Hawaiian Sugar Planters' Association has established an entomologist there, as on Midway Island [*cf. R.A.E.*, A **28** 252], with a view to intercepting any potential insect pests and preventing their introduction into Hawaii.

Brief accounts are given of the topography, flora and fauna of Canton Island. The author carried out a survey of insect life there during the summer of 1940; the few undesirable insects found included *Prodenia litura*, F., an unidentified Jassid found on *Boerhaavia diffusa*, the Arctiid, *Utetheisa pulchelloides*, Hmps., on *Tournefortia argentea*, and *Achaea janata*, L., larvae of which occurred on *Cordia subcordata*, and which is of potential importance as a fruit-piercing moth. Almost all the insects that enter the aircraft at Canton are flies, of which some are already present in Hawaii and none is of economic importance.

SWEZEY (O. H.). **Observations on Insect Pests in Samoa which are not yet known to occur in Hawaii.**—*Hawaii. Plant. Rec.* **45** no. 1 pp. 25–38, 18 figs. Honolulu, 1941.

During an expedition to Samoa from 27th May to 5th September 1940, a survey was made of crop pests that occur there but are not known to be present in Hawaii. A list of over 70 species is given, together with notes on their importance and distribution. The more important include *Perkinsiella vitiensis*, Kirk., on sugar-cane; *Oryctes rhinoceros*, L., and *Promecotheca reichei*, Baly, on coconut; *Nacoleia octasema*, Meyr., and *Cosmopolites sordidus*, Germ., on banana; and *Prodenia litura*, F., on taro [*Colocasia*] and occasionally on banana, tobacco and other plants.

Perkinsiella vitiensis is also present in Fiji, where it is considered to transmit Fiji disease of sugar-cane [cf. *R.A.E.*, A **24** 434]. This disease also occurs in Samoa, where sugar-cane is not grown to any great extent. Two parasites, *Paranagrus optabilis*, Perk., and *Ootetrastichus beatus*, Perk., were reared from eggs of this Delphacid. Considerable infestation of the leaves of coconut and other palms by *P. reichei* occurred on Pago Pago Island at the U.S. Naval Station, but no evidence of attack was observed on any other part of the island or on Upolu. *N. octasema* is destructive throughout Samoa, the larvae feeding on the skins of the young bananas and causing a scabby, unmarketable appearance in the mature fruits. In some cases the larvae ate into the fruits, the whole bunch being ruined. Packing is complicated by the fact that the fruits have to be cut from the bunch and the scabby ones discarded. Although *C. sordidus* is very injurious in some of the countries in which it occurs, it is not sufficiently abundant in Samoa to cause significant damage. *Prodenia litura* is the most important pest of taro in Samoa. The eggs are deposited in clusters of several hundred on the lower surface of the leaf, and the larvae skeletonise the leaves. A few larvae were parasitised by a species of *Euplectrus*.

Insect Pests.—*Agric. Gaz. N.S.W.* **52** pt. 3 pp. 171–175, 6 figs. Sydney, 1941.

This part of a series [cf. *R.A.E.*, A **29** 608] includes a section on the control of the usual pests of tomato in New South Wales, in which it is stated that experiments by W. L. Morgan showed that the most satisfactory control of *Macrosiphum solanifolii*, Ashm., was given by a spray of 16 fl. oz. nicotine sulphate (Black Leaf 40) in 40 gals. weak Bordeaux mixture (1:1:40). It was not improved by the addition of a spreader. The Bordeaux mixture activates the nicotine and increases its efficiency, while if used at the above concentration, it does not cause any serious spray injury [cf. **26** 210]. The spray should be applied weekly, and care should be taken to cover the lower surfaces of the leaves, the tops of the plants, the young fruits and the blossoms. Nicotine dusts were not effective against Aphids on tomatoes.

Plant Investigations.—*Rep. Coun. sci. industr. Res. Aust.* **14** (1939–40) pp. 7–16. Canberra [1941]. **Entomological Investigations.**—*T.c.* pp. 16–24.

This report deals with work in Australia in the year ending 30th June 1940. In experiments on yellow-dwarf of tobacco in Victoria,

typical symptoms appeared in previously healthy plants after feeding by brown Jassids, but the disease was not transmitted by green Jassids, yellow Jassids, Capsids or the Rutherglen bug [*Nysius vinitor*, Bergr.], all of which were abundant in infected fields. Preliminary field surveys at Canberra and in Victoria suggest that *Myzus persicae*, Sulz., is the main insect vector of potato virus diseases in Australia. Transmission tests in greenhouses have shown the ability of this Aphid to transmit viruses A and Y and leaf-roll under Australian conditions.

An outstanding development in work on the biological control of noxious weeds was the discovery of an established colony of *Chrysomela* (*Chrysolina*) *hyperici*, Forst., attacking St. John's wort (*Hypericum perforatum*) over an area of $1\frac{1}{2}$ acres in a locality in eastern Victoria where beetles imported from England had been liberated in 1934 [cf. R.A.E., A 23 397, etc.]. This Chrysomelid aestivates during the summer, and the eggs are laid on young winter growth during late autumn and early winter. Many plants in the area were completely destroyed, and native plants were gradually becoming re-established. Large numbers of the beetles were liberated at other places in the district and in New South Wales, and liberations of *Agrilus hyperici*, Crtz. [cf. 29 143] were also made in eastern Victoria. *Teleonemia scrupulosa*, Stål, from the well-established colony on *Lantana camara* in northern Queensland [28 566] was released in several coastal areas in the State; where colonies are firmly established [cf. 29 467], the rate of spread is stated to be approximately 1 mile per month. Consignments were sent to northern New South Wales, where a colony became established but was destroyed by a bush fire, to Norfolk Island, where evidence indicates that a generation has developed in the field, and by air to Java. Feeding tests with the Lamiids, *Nupserha antennata*, Gah., which attacks *Xanthium spinosum* in India, and *Dectes spinosus*, Say, and *Mecas saturnina*, Lec., which attack it in Texas and the neighbouring States, showed that the Indian species also feeds on sunflower [*Helianthus annuus*] and the American ones on sunflower and Jerusalem artichokes [*H. tuberosus*]; they are therefore unsuitable for introduction into Australia. Large numbers of *Euaresia aequalis*, Lw., imported from the United States were liberated in Queensland, and a second Australian generation of this Trypetid was observed there on *X. spinosum* in the field.

Adults of *Cydia molesta*, Busck, were not numerous in the Goulburn Valley in the spring of 1939, as a result of heat-waves during the previous summer [cf. 29 141]; after an increase in the first generation, its numbers decreased in the second and third generations, probably owing to cool evening breezes in December and January and early frosts in February. The population increased a little late in the season, and quinces and late peaches were lightly infested. Only a few infested peach twigs were found in two orchards in the Murrumbidgee irrigation areas in the spring of 1939, and no moths were trapped. Although only small numbers of *Macrocentrus ancylivorus*, Rohw., survived the summer of 1938-39 [29 141], a few were recovered in the spring of 1939 before any liberations had been made. Consignments of this Braconid received from the United States were released in the spring at numerous localities, and recoveries were made in seven widely scattered orchards at the end of the season; the numbers of parasites in the field showed a marked increase during the latter part of the season.

Analyses of outbreaks of *Chortoicetes terminifera*, Wlk., in New South Wales in 1937-38 and 1938-39 showed that there is, in addition to the lower limits of temperature and moisture [29 141], an upper limit of moisture that is fatal to all stages. Hoppers and adults die if conditions remain unfavourable for more than a few weeks, but eggs can survive dry conditions in the field for about three months, and cold conditions for at least five. The dates on which the various stages of the life-cycle appear are determined primarily by the dates on which temperature and soil moisture become favourable. The tendency for swarms to migrate to regions of increased humidity at first serves to prolong an outbreak, but eventually leads to its extinction when over-moist conditions arise. The number of generations that occurred at any place in any season can be estimated by means of a climatic index, which is the sum of all monthly mean temperatures over 57.5°F. (the threshold for development in terms of mean monthly temperatures) occurring during the favourable months of the season. An index of 36.5 is required for one generation, and one of 73.0 for two. In 1939-40 [cf. 29 466], swarms spread south and east in November and December, but drought conditions over the greater part of New South Wales, and heavy rains in the Darling Downs, destroyed most of the locusts and little damage was done. Distribution over the area studied in New South Wales, mainly under conditions of drought, is not uniform. There is a tendency for individuals to concentrate in small areas, the adults generally occurring in slight depressions characterised by the presence of tufts of grass or other plants 2-3 ft. high with more or less bare ground between them, and the hoppers where there are green food-plants.

The foliage yield of first-season subterranean clover [*Trifolium subterraneum*] in plots artificially infested with *Halotydeus destructor*, Tucker, in Western Australia, was lower than that from those kept free from mites by an amount that was just significant; the seed yield from the infested plots was greatly reduced, and the plants wilted much earlier at the end of the season. The autumn of 1940 was very dry, and the infested plants suffered severely, whereas the uninfested clover remained healthy. A large consignment of the parasite, *Triaspis thoracicus*, Curt., was imported from France, and 1,640 individuals were liberated against *Bruchus pisorum*, L., in three pea-growing areas in Western Australia, from one of which this Braconid was subsequently recovered.

Since species of *Coptotermes* are responsible for most of the damage caused by termites in Australia, the standard laboratory-colony testing technique developed with *Eutermes exitiosus*, Hill [27 545] was successfully adapted to *C. lacteus*, Frogg., which, though less abundant near Canberra than *E. exitiosus* and less destructive than *C. acinaciformis*, Frogg., is common and widely distributed. The data obtained indicate that results with it can be applied, in general, to *C. acinaciformis*. The colonies were fed on susceptible wood (*Eucalyptus regnans*), but the percentage survival of *C. lacteus* at the end of 12 weeks was lower than that of *E. exitiosus*. Laboratory colonies of *C. acinaciformis* were successfully set up in Canberra from a nest taken from a living ironbark [*Eucalyptus*] in southern Queensland. The weight of *Eucalyptus regnans* consumed by this species in 12 weeks was rather more than 40 gm. per colony, whereas colonies of 5,000 of *E. exitiosus* and 6,000 of *C. lacteus* (which are equivalent in weight) each consumed about 25 gm. Finely powdered white arsenic

gave better control of termites than other insecticides [*cf.* 29 142], and did not appear to be repellent to them; *E. exitiosus* seems to be more susceptible than *C. lacteus*. A method of comparing the effects of different dosages and treatments made under various conditions was devised, utilising the special structure of mounds of *C. lacteus*, the outer walls of which contain relatively few galleries in which only small numbers of termites occur. A slab of the wall is removed with a mattock, the poison placed in these galleries, and the wall replaced with as little disturbance to the termites as possible. Since to be effective, the poison must be carried into the more populous part of the nest by the termites, the factors on which the success of the treatment depends are the same as those obtaining in termite-infested buildings. Results so far obtained indicate that a well-populated colony can be exterminated by as little as $\frac{1}{8}$ oz. white arsenic. Observations on incipient colonies were continued [29 142]. New colonies did not survive when the relative humidity was as low as 90 per cent., but development continued when it was 95 per cent.

Tests in Rabaul indicated that an alcoholic solution of boric acid affords satisfactory protection to books against insect pests and moulds under tropical conditions; the solution is safer than one containing mercury bichloride (corrosive sublimate), and does not tarnish gilt lettering.

JENKINS (C. F. H.). **Termites or "White Ants."**—*J. Dep. Agric. W. Aust.* (2) 18 no. 1 pp. 22–26, 6 figs., 3 refs. Perth, W.A., 1941.

Notes are given on the habits of earth-dwelling termites, which include the species that cause most injury in Australia, and on preventive and control methods for use against them. Resistant timber should be used for buildings and fences, if possible, and ground that is to be built on or planted should be thoroughly cleared of all stumps, roots and timber likely to harbour termites. Trees should be injured as little as possible, as dead roots or scars near the ground induce attack, and badly infested trees should be removed. Buildings should contain as little timber as possible in contact with the soil, and that should be suitably treated; piers and piles supporting floors should be capped with metal [*cf.* R.A.E., A 17 730]. The timber should be protected with coal-tar creosote, either by vacuum treatment or by dipping, painting or spraying. Better penetration results from soaking the wood for some hours in heated creosote than from a cold dip. If the timber is not exposed to wet conditions, a solution of sodium arsenite (1 lb. in 2 gals.) or white arsenic may be used.

If a building is infested, the most effective control in dry situations is obtained by blowing finely ground white arsenic, Paris green or sodium fluosilicate into cracks or holes bored in the timber; these should be plugged and left undisturbed for at least a month. The amount of dust to be injected depends on the size of the timber, but 1 oz. should be sufficient for 20–30 holes; the termites should be disturbed as little as possible. The nest should be dug up if possible and drenched with creosote, and ground that may be infested should be soaked with creosote, creosote and kerosene, or even sump-oil, or with saturated solutions of copper sulphate or borax, unless the soil is to be cultivated. Lightly infested trees can be preserved by injecting poison dusts into holes bored in the infested trunk just above ground level and in the branches and subsequently plugged. Injecting the dust

into the pithy centre of the trunks of grape-vines has been found effective in New South Wales. If the roots of a plant are attacked, 2 oz. paradichlorobenzene should be scattered in a trench 3-4 ins. deep and 6-9 ins. from the base of the plant, and the trench should be filled in. This treatment is more effective in warm soil, but is useless when the soil is saturated with water. Poison baits may be used in conjunction with other methods; a bait made by heating together 1 lb. molasses and 4 oz. sugar and adding 1 oz. sodium arsenite dissolved in half a cup of boiling water, should be smeared on soft-wood boards that are attractive to termites. Two boards with the treated sides touching should be buried in the ground near places where termite activity is suspected.

POSNETTE (A. F.). **Swollen-shoot Virus Disease of Cacao.** (Review of Research Work to November 1940.)—*Trop. Agriculture* 18 no. 5 pp. 87-90, 1 fig., 9 refs. Trinidad, 1941.

A brief account is given of the history and symptoms of the swollen-shoot disease of cacao, which has probably been present in the eastern part of the Gold Coast Colony for at least ten years and is spreading rapidly. The main centre of infection is near Akwadum, with scattered outbreaks towards the Ashanti border, and an area of about 250 square miles is too severely affected to justify control measures. The symptoms and severity of the disease vary, but, in general, chlorosis of young leaves, accompanied by leaf shedding, occurs on infected plants, subsequent flushes of leaves being much reduced. After some months, defoliation is complete; die-back follows rapidly, and the death of the trees is inevitable. In some areas, shade appeared to delay infection, but in others it did not affect the spread of the disease. The condition was found to be caused by a virus, transmissible by budding and sometimes through the seed. In attempts to discover an insect vector, all available cacao-sucking Rhynchota were fed on infected plants and then caged on healthy seedlings. Three of the species, *Mesohomotoma tessmani*, Aulm., *Toxoptera aurantii*, Boy., and *Selenothrips (Heliothrips) rubrocinctus*, Giard, are considered possible vectors, since they attacked plants of all ages, were more numerous on unshaded than on shaded cacao, were sufficiently common to account for radial spread from the original infected tree, and are small enough to be wind-borne for considerable distances; *M. tessmani* is, however, the only species with which positive results have so far been obtained.

HEDAYETULLAH (S.). **Annual Report of the Economic Botanist, Bengal, for 1939-40.**—*Rep. Dep. Agric. Bengal 1939-40* pt. II pp. 1-18. Alipore, 1941.

This report contains a section (pp. 14-17) on insect pests observed in Bengal during 1939-40. *Schoenobius bipunctifer*, Wlk., was locally very injurious to transplanted rice, but it was controlled to a great extent by draining the fields and by the activity of two unidentified Chalcidoids, which parasitised the eggs. Larvae of *Spodoptera mauritia*, Boisd., occurred on rice in two districts, in one of which they were destroyed by floods and in the other by cattle egrets (*Bubulcus coromandus*). These birds should be protected and their presence encouraged by allowing cattle to graze near the rice-fields when the larvae appear. *Hispa armigera*, Ol. (*aenescens*, Baly) injured rice in one area

and was controlled by draining the fields and by spraying against the adults with a mixture of kerosene emulsion and pyrethrum extract. Pests of sugar-cane included *Scirpophaga nivella*, F., and *Argyria tumidicostalis*, Hmps., which caused severe damage in one locality but were kept in check by destroying the dead hearts, and *Pyrilla pusana*, Dist. This Lophopid was extremely abundant in three districts, in one of which large numbers of adults and nymphs were destroyed by a fungus; egg-parasites also exerted some control. *Sphenoptera gossypii*, Cotes, and *Sylepta derogata*, F., occurred on cotton, and ratoon cotton in one district was severely infested by *Cerococcus hibisci*, Green. Flax was attacked by larvae of *Diacrisia obliqua*, Wlk., and all the plants on one plot were destroyed by cutworms (*Agrotis ypsilon*, Hfn.). Mustard was infested by *Athalia proxima*, Klug, and *Brevicoryne (Aphis) brassicae*, L.; the latter also attacked cabbage and cauliflower but was controlled on them by spraying with kerosene emulsion.

CHAUVIN (R.). *Sur le grégarisme du criquet pèlerin (Schistocerca gregaria Forsk.)*.—*C. R. Acad. Sci.* **212** no. 4 pp. 175–177, 3 refs. Paris, 1941.

Husain & Mathur [*R.A.E.*, A **25** 161] have obtained black pigmentation, typical of phase *gregaria*, in solitary hoppers of *Schistocerca gregaria*, Forsk., by breeding them in an atmosphere rich in carbon dioxide, but this blackening can be obtained in the case of two hoppers confined in a small open cage, in which there can be no excess of carbon dioxide in the atmosphere. In experiments by the author, solitary hoppers isolated from each other by partitions of metal, glass, gelatin, cardboard or wire-netting became gregarious if the partitions were transparent, but not otherwise. The sense of vision, however, is not always necessary for the transformation, since crowded hoppers became gregarious even when kept in complete darkness. The senses of smell and hearing can be eliminated, for hoppers isolated in small cages placed side by side with cages containing hundreds of *gregaria* hoppers remained in phase *solitaria*, while amputation of the antennae and palpi or perforation of the tympana did not prevent rapid transformation of crowded hoppers to the gregarious phase. Such transformation, therefore, appears to be influenced mainly by contact with other hoppers, and also by their visual perception of each other; in the author's opinion, a kind of conditioned reflex causes the formation of the pigments characteristic of phase *gregaria* and other physiological phenomena associated with that phase. He rejects the theory that the transformation is the result of the greater activity of crowded hoppers [**20** 672; **24** 737] as, in his experiments, both crowded and isolated hoppers showed little activity, but assumed phases *gregaria* and *solitaria*, respectively.

MÉTALNIKOV (S.). *Utilisation des microbes dans la lutte contre les insectes nuisibles*.—*C. R. Acad. Sci.* **213** no. 16 pp. 533–535. Paris, 1941.

The results obtained in the control of vine moths in France and Algeria by spraying with a suspension of the dried spores of bacteria are briefly reviewed [*cf. R.A.E.*, A **26** 619; **28** 500]. The effectiveness of the method was confirmed in Switzerland in 1939, when about 90 per cent. control was achieved.

KEARNS (H. G. H.) & MARTIN (H.). **The Preparation of Dinitro-ortho-cresol Emulsions.**—*Rep. agric. hort. Res. Sta. Bristol 1940* pp. 55-56, 1 ref. Bristol [1941].

Dinitro-ortho-cresol is becoming increasingly popular in Great Britain as an ingredient for winter sprays against pests of fruit trees. It is only slightly soluble in water, but is fairly soluble in mineral oil, and a combination of the two provides an ovicidal spray that gives results equal to those obtained by separate applications of tar-oil and petroleum-oil emulsions and avoids the risk of bud injury that sometimes follows the application of combined tar-petroleum sprays.

A concentration of 0.1 per cent. dinitro-o-cresol (1 lb. per 100 gals.) gives good control of the eggs of Aphids and sucker [*Psylla mali*, Schm.] on apple, although lower concentrations may sometimes be used with satisfactory results. A spray containing not less than 3 per cent. petroleum oil (conforming to the grade E specification as given in a paper already noticed [cf. *R.A.E.*, A 23 497]) is necessary for reasonable control of eggs of *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.) and to ensure the satisfactory spreading of the dinitro-cresol on the bark and eggs, while 5 per cent. is required for control of Capsids on apple [cf. 29 108]. Sprays containing either concentration of oil can safely be applied within two weeks of bud burst to all kinds of fruit and are conveniently prepared from a stock emulsion. To make the latter, the dinitro-o-cresol is dissolved in the oil at the rate of 1 lb. per gal., the oil being heated in a steam-jacketed tank to about 95°C. [203°F.]. The solution is then pumped into twice the amount of oil at normal temperature. The emulsifier is prepared by diluting 1 volume concentrated sulphite lye (60°TW., *d* 1.3) with 9 volumes of water, and every 3 gals. of cooled oil and cresol is made up to 4½ gals. with the diluted sulphite lye. The mixture is constantly stirred by a mechanical agitator, or by passage through a gear type pump of large capacity, and fed by gravity through a 5 in. Premier Colloid Mill or other emulsifying equipment. The emulsion should be of a light yellow colour, and it may be necessary to mill it twice to ensure that all the oil has been emulsified. This stock emulsion is diluted at the rate of 4½ gals. to 95½ gals. water, to provide a spray containing 0.1 per cent. dinitro-cresol and 3 per cent. oil. If a spray containing 5 per cent. oil is required, 3 gals. of petroleum-oil emulsion prepared in the same manner is added to the stock before dilution.

The preparation of dinitro-o-cresol emulsions should not be undertaken by growers because the chemical is dangerous to handle, their preparation requires special equipment and knowledge, and incorrectly prepared emulsions may cause extensive damage to trees and bushes. The compound is marketed commercially in the form of a powder, as "beans" and as a paste. To avoid danger to health and undue staining of the skin, the dry material must be handled with care, and a suitable respirator and protective clothing should be worn. The paste is the easiest to handle in bulk quantities, as particles do not become dispersed into the air.

The emulsion is best stored in large open-topped, circular cisterns, fitted with tight covers, and should be agitated thoroughly before being run off into smaller containers. It should be prepared each season to avoid corrosion of the container, but if long storage is essential, it is

well to cover the metal surface of the storage bin with bitumen paint or a heavy water pump lubricating grease. Under all circumstances the emulsion must be agitated before dilution with water.

KEARNS (H. G. H.) & MARTIN (H.). **War-time Winter Spraying for the Control of Insect Pests of Fruit.**—*Rep. agric. hort. Res. Sta. Bristol 1940* pp. 57–62. Bristol [1941].

The principal winter sprays available for use on fruit trees and bushes in Great Britain and the technique of applying them are briefly reviewed, and spray programmes are recommended to meet the requirements of a time when labour is short and materials are costly.

KEARNS (H. G. H.). **A Note on a *Lonchocarpus nicou* Dust for the Control of the Cabbage White Butterfly.**—*Rep. agric. hort. Res. Sta. Bristol 1940* p. 80. Bristol [1941].

Young and full-grown cabbage caterpillars [*Pieris*], which are a serious pest of cruciferous crops in Britain in June and from August to early October, are readily killed by sprays and dusts containing rotenone, but dusts are the more convenient and economical to apply. A dust suitable for treating cruciferous crops should flow readily from hand or power-driven blowers, should settle on the leaves rapidly, even in a light wind, and should adhere to them and to the larvae. Most commercial dusts contain not less than 0·2 per cent. rotenone in the form of *Derris* or *Lonchocarpus*, but satisfactory control under field conditions has been obtained with one containing only 0·1 per cent. prepared from the ground root of a species of *Lonchocarpus* that contains 4 per cent., here stated to be *L. nicou* [but cf. *R.A.E.*, A 26 319, etc.]. The dust is made by mixing 2½ lb. finely ground root with 5 lb. amorphous silica dust by rotation in a ball mill, and then gradually adding 92½ lb. gypsum. Homogeneity was quickly attained, and a satisfactory dust could be made even in a converted hand-operated milk churn. The dust cost 14s. per cwt. for material, and about 70 lb. per acre was required to treat a crop in autumn.

STIRRETT (G. M.) & THOMPSON (R. W.). **Spraying for the Control of the European Corn Borer in Sweet Corn.**—*Rep. ent. Soc. Ont. 71* (1940) pp. 9–15, 2 figs. Toronto, 1941.

The effectiveness of sprays of derris and cryolite against *Pyrausta nubilalis*, Hb., on sweet maize was tested in two localities in Ontario in 1940. The sprays consisted of 2 lb. ground derris root (4 per cent. rotenone) and a commercial spreader in 40 gals. water, and ½ lb. synthetic cryolite and 1 lb. bentonite in 40 gals., and the rates of application were 142 and 320 gals. per acre. The higher rate was found to be excessive. The spray was directed into the whorl of each plant, and later in the season the tassels were also treated. At Chatham, spraying was begun on 12th July, within three days of the first eggs being observed, but at Guelph, where oviposition was almost two weeks later, the first spray was applied on 26th July, when the eggs began to hatch. Either two or five applications were made, at intervals of approximately five days.

The results are given in tables. Both derris and synthetic cryolite increased the percentage of uninfested ears as compared with the controls, five applications of either material being slightly more effective than two, but the cryolite sprays considerably reduced the number of ears produced by the plants, and caused a marked yellowing of the foliage that persisted throughout the season. Derris caused no noticeable injury. All the treatments, with the exception of two applications of cryolite, showed profits; five applications of derris was the most profitable, and two applications of derris were more profitable than five of cryolite.

THOMPSON (R. W.). **Hybrid Corn in the Corn Borer Control Program, with Notes on the Situation in Ontario in 1940.**—*Rep. ent. Soc. Ont.* **71** (1940) pp. 16-20. Toronto, 1941.

Investigations on the resistance of various strains of maize to the European corn borer [*Pyrausta nubilalis*, Hb.] in Ontario [cf. *R.A.E.*, A **29** 303] were continued in 1940, when hybrid and standard varieties were tested at two stations. The average borer populations at each station in 1940, and also in 1939 and 1938 for the strains that were grown in the last two or all three years, are shown in tables. Some hybrids showed small borer populations throughout the three years, but resistance was difficult to demonstrate. In all but a very few cases the hybrids had stiffer or sturdier stalks, and, given strains producing grain equal in quality and quantity to standard varieties, the hybrids should yield more grain per acre than standard varieties. There was a large increase in borer abundance in 1940, the percentage of stalks infested ranging up to 81 in one county, and many growers experienced serious loss for the first time on record. Sweet maize was particularly affected.

HAMMOND (G. H.). **Feeding Habits and vertical Movements of Third-year Grubs of *Phyllophaga anxia* Lec.**—*Rep. ent. Soc. Ont.* **71** (1940) pp. 20-22. Toronto, 1941.

The feeding habits and migration in the soil of third-instar, third-year larvae of *Lachnosterna* (*Phyllophaga*) *anxia*, Lec., a pest of agricultural crops in Ontario [*R.A.E.*, A **29** 89], were investigated in 1940 in Hastings county.

The population of third-year larvae was found to average 17.32 individuals per sq. yd. Observations at intervals of about five days from 7th May to 14th October of soil in sod land showed that while a limited number of third-year larvae approached the surface during the later part of May, the great majority remained at a considerable depth not far from the levels at which they had hibernated. Larvae feeding in sod land are usually found at a depth of 1 inch. Larvae at or above 2 inches are considered to be in the feeding zone, and those at lower levels are regarded as not feeding at all. They are largely inactive except for minor vertical movements, and pupate close to the level at which they have hibernated. The numbers of third-year larvae (including pupae and adults resulting from them) found in various periods at depths down to 18 inches are shown in a table. The percentages found below the feeding level were 99.35 from 7th to 22nd May, 87.64 from 27th May to 15th June, 92.79 from 19th June to 9th July, 97.66 from 9th July to 28th August, 98.23 during 4th-8th September,

and 100 on 14th October. Over the whole season, 72.5 per cent. occurred between 4 and 10 inches, and about 94 per cent. were below the two-inch level.

The larvae under investigation arose from the major flight of 1938, caused severe losses in 1939 over a large part of Ontario, and transformed to the adult stage in the late summer of 1940; this indicated that another major flight would occur in 1941, and the next year of severe white grub injury in most of Ontario would be 1942. The third-year larvae found in the feeding zone fed actively, but did so for somewhat less than a month, as compared with about four months for second-year larvae. As the great majority do not feed, stomach poisons would be of much less value than they are against larvae in their first or second years. The maximum depth of ordinary ploughing is six inches, and much is shallower than this, so that larvae, pupae and adults below that depth are unaffected by it.

PICKETT (A. D.), PATTERSON (N. A.), CAMERON (J. MacB.) & NEARY (M. E.). **Field Experiments for the Control of the Mullein Leaf Bug *Campylomma verbasci* Meyer, in Nova Scotia Apple Orchards.**—*Rep. ent. Soc. Ont.* **71** (1940) pp. 23–25, 1 ref. Toronto, 1941.

Following the serious outbreak of *Campylomma verbasci*, H.-S., on apple in Nova Scotia in 1938 [*R.A.E.*, A **28** 430], this Capsid caused no important injury in 1939, but was more numerous in 1940, when some highly susceptible varieties of apple in a few orchards were rendered almost a total loss. In preliminary trials in 1938 [*cf. loc. cit.*], the usual sprays applied against apple bugs were unsatisfactory against *C. verbasci*, owing to inefficient wetting, and field tests were therefore made in 1940 with dusts and sprays of pyrethrum and nicotine sulphate, proprietary wetters being included in the sprays, and a proprietary rotenone spray alone. The sprays were applied at the rates of 6 gals. per tree to one block of trees in bloom and 8 gals. per tree to another about a week after petal-fall. The dusts were applied under poor weather conditions two days later, and were less effective than the sprays. Of these, the post-blossom sprays were the more effective, possibly owing to the lack of protection by the blossoms at this time. All the treated trees showed a marked reduction in infestation, and failure to achieve complete control by spraying is considered to be due to the difficulty of covering all parts of the tree where the insects occur.

MATTHEWMAN (W. G.). **Two Experiments which show promising Control of the Columbine Borer, *Papaipema purpurifascia*, G. and R., (Phalaenidae).**—*Rep. ent. Soc. Ont.* **71** (1940) pp. 26–29, 1 ref. Toronto, 1941.

Since experiments in Ottawa on the control of *Papaipema purpurifascia*, Grote & Rob., on cultivated *Aquilegia* [*cf. R.A.E.*, A **25** 785] showed that sprays and dusts applied to the soil to kill the overwintering eggs were ineffective, investigations were carried out on the control of the newly hatched larvae. Tests on a small scale in 1938–39 and others in 1940 showed that dusts of derris mixed with talc are effective if applied during the hatching period to the foliage of the plants and the soil round them. In 1940, the dusts were applied four times at intervals of 3–4 days, beginning on 13th May, on plots 8 by 9 ft. in size, of which each had been artificially infested with 500 eggs in the preceding autumn.

and contained 20 plants. The percentage viability of the eggs in spring was shown to be 96. Hatching began on 18th May and was complete within five days. The plants were dissected for larvae on 5th–21st June, and the results showed that a dust containing 2.5 per cent. rotenone applied one, two, three and four times at a rate equivalent to 250 lb. per acre gave 62.5, 75.2, 94.2 and 92.2 per cent. control, as calculated by Abbott's formula [13 331]. Four applications at half the rate per acre gave 86.4 per cent. control, and four at the full rate of dusts containing only 1.6 and 1 per cent. rotenone gave 92.2 and 89 per cent., respectively. It is considered that four applications of the 1 per cent. dust at 125 lb. per acre would afford sufficient protection to the plants for a fortnight, which should cover the period of hatching in normal years, and that in eastern Ontario, the first should be made about 5th May, except in late seasons.

A further experiment with artificially infested plants showed that 98.5 per cent. control of the Noctuid was given by transplanting in the spring before the eggs hatched. In doing so, the top inch of soil should be knocked away from the crowns to eliminate the eggs, but the remaining soil should be left on the roots. This should be done about 1st May, and the plants do not suffer. Newly hatched larvae did not migrate for more than 15 ft.

SMITH (C. W.). **Successful Hibernation of the Earwig Parasite *Bigonicheta setipennis* Fall. in Ontario.**—*Rep. ent. Soc. Ont.* **71** (1940) pp. 29–32. Toronto, 1941.

The European earwig, *Forficula auricularia*, L., was discovered in Grey county, Ontario, in 1938 [cf. *R.A.E.*, A **27** 601], and its parasite, *Bigonicheta setipennis*, Fall., was introduced from British Columbia; 21,472 mated females of this Tachinid were released in 1939 and 18,434 in 1940. To determine the ability of the parasite to hibernate successfully, batches of puparia in suitable containers were placed out of doors in the winter of 1939–40, and others were kept in cold storage. The lowest outdoor temperature recorded was -20°F . The highest percentages of emergence in spring, 82 and 80, resulted from puparia stored at 32 and 36°F ., respectively. Among the lots that overwintered out of doors, there was no sharp demarcation between those in exposed and those in sheltered places, but the greatest survival (over 60 per cent. in some cases) was in the sheltered situations, where puparia are most likely to be found. The poorest survival was in puparia below the soil surface, and in those subjected to the extreme conditions of a southern exposure.

DUSTAN (G. G.). **The Symphyliid, *Scutigerella immaculata* (Newp.), as a Pest of Greenhouse Crops in Ontario.**—*Rep. ent. Soc. Ont.* **71** (1940) pp. 33–39, 1 fig., 5 refs. Toronto, 1941.

Scutigerella immaculata, Newp., was observed in a greenhouse near Grimsby, Ontario, in 1938, and has probably been present in the Province for a long time. Its various stages and process of development are briefly described. The two main types of injury that it causes to plants are the total destruction of the smaller roots and the boring of small shallow holes in the larger roots and subterranean portions of the stem. In the heaviest infestation seen by the author, over 85 per cent. of the plants in a bed of *Ranunculus* were killed and the remainder

stunted, some plants having up to 30 individuals around the roots. Plants of snapdragon [*Antirrhinum*] picked at random showed 23–58 holes per stem. A list is given of plants in which injury was observed.

An experiment was carried out in 1940 to determine the effect of drying the soil on the size and distribution of the population in it. Two ground beds containing 18 ins. of well packed subsoil, 9 ins. of cinders for drainage, and 9 ins. of top soil from an infested source, and two raised beds filled to a depth of 5 ins. with the infested soil were set on 9th June with lettuce, tomatoes and radishes, and watered normally until 1st August, after which one of each was left unwatered until 3rd September, when the soil was examined. The results are recorded in tables. Contrary to expectation, there was little difference in vertical distribution between the two ground beds. The maximum concentration in both was in the inch of soil just above the cinders, and in the raised beds in the lower inch of soil. In the moist ground bed, almost all the eggs and younger forms occurred in the top soil; breeding had apparently ceased in the dry beds, and no unhatched eggs were observed.

In preliminary experiments on infested Easter lilies in 6-in. pots at a soil temperature of 60°F. good mortality was given by emulsions of carbon bisulphide and dichloroethyl ether; solutions of nicotine sulphate and mercury bichloride (corrosive sublimate) were much less effective. Greenhouse tests with the two emulsions gave inconclusive results, and the plants were injured by the treatments in some cases. An apparently high degree of control was given by injecting carbon bisulphide into infested soil and covering it with a tarpaulin or watering it, by applying this treatment to the cinders after the top soil had been removed for steam sterilisation, and by steam sterilisation at a temperature of 210°F. at a depth of 6 ins., but the last treatment was not effective in all cases.

BOYCE (H. R.). **Biological Control of the Codling Moth in Ontario.**—*Rep. ent. Soc. Ont.* **71** (1940) pp. 40–44, 4 refs. Toronto, 1941.

The results are given of observations in 1937–40, mainly in three typical apple orchards in the Niagara district, on the extent to which *Cydia* (*Carpocapsa*) *pomonella*, L., is controlled by natural enemies and diseases in Ontario. The only egg parasite observed was *Trichogramma embryophagum*, Htg. [probably the species commonly called *T. pretiosum*, Riley (cf. *R.A.E.*, A **25** 719, etc.)], and a detailed study of its abundance was impracticable. The commonest parasite of the larvae was *Ascogaster quadridentata*, Wesm. (*carpocapsae*, Vier.), and in the three orchards the percentages of parasitism by it of larvae taken in trap bands were 24.6, 22 and 20.4 in 1937; 21.2, 7 and 21.8 in 1938; 9.1, 7.8 and 15.6 in 1939; and 8.5, 1.7 and 5.9 in 1940, respectively. Several species of *Perilampus*, including *P. fulvicornis*, Ashm., and *P. tristis*, Mayr, parasitised *A. quadridentata*. Other parasites of the larvae of *C. pomonella* were *Dibrachys cavus*, Wlk., *Macrocentrus delicatus*, Cress., *M. instabilis*, Mues., *M. ancylivorus*, Rohw., and *Phanerotoma* sp., but none afforded any appreciable control. The pupae were singularly free from parasitism. *D. cavus* was reared on several occasions as an external parasite of the prepupa and as an internal parasite of the pupa; single examples of *Eupelmus cyaniceps*, Ashm., and *Eurytoma* sp. were reared from pupae in 1938, and 3 individuals of *Pimpla inflata*, Townes [**29** 220] emerged from pupae in 1940.

Insects predacious on the larvae were the Trogositid, *Tenebroides corticalis*, Melsh. (the most important), the Reduviid, *Acholla multi-spinosa*, DeG., the Nabid, *Pagasa fusca*, Stein, and *Solenopsis molesta*, Say. Woodpeckers (*Dryobates* spp.) were most effective predators on the larvae and destroyed 67.1 per cent. of those overwintering on three trees in 1937-38, and 94.7 and 80 per cent. on two pairs of trees in 1938-39.

Diseases were of little importance, but in 1940 a virus or bacterial disease was more prevalent in several orchards, and in one caused a mortality of 15-16 per cent. of the larvae in the trap bands.

Initial releases of the introduced Ichneumonid, *Ephialtes caudata*, Ratz. [see next abstract], which parasitises larvae that have spun cocoons, were made in the Niagara district in 1940, 160 mated females being released in August and September in one orchard and 250 in another; two parasitised larvae were observed in the former early in October.

NAPHTALI (D. K.). The Introduction of two European Parasites of the Codling Moth, *Carpocapsa pomonella* L., into Canada.—Rep. ent. Soc. Ont. 71 (1940) pp. 44-47, 4 figs. Toronto, 1941.

Parasitised cocoons of *Cydia* (*Carpocapsa*) *pomonella*, L., collected in France and received in Ontario on 11th June 1940 gave rise to 4 males and 6 females of *Ephialtes caudata*, Ratz., and 9 males and 1 female of *Cryptus sexannulatus*, Grav. The methods by which these Ichneumonids were bred in the laboratory are described. The adults of *C. sexannulatus* obtained from the F_1 , F_2 and F_3 generations comprised 4, 49 and 10 males and 5, 7 and 3 females, respectively; a large proportion of the larvae of the F_2 and F_3 generations went into diapause and were in storage at the date of writing. The parasite developed satisfactorily on both mature larvae and pupae in cocoons, complete development and the preoviposition period lasting about 22-23 and 6 days, respectively, at 70°F.

Adults of *E. caudata* paired readily, often when freshly emerged. The original adults gave rise to an F_1 generation of 86 males and 85 females, and an F_2 generation of 476 males and 463 females. The last of the F_2 and F_3 generations and all the F_4 generation went into diapause. Eggs were laid on larvae and pupae in cocoons, but it is doubtful whether the parasites emerge from pupae of the moth. Females during the preoviposition period, and to some extent males also, fed on the body juices of host larvae, many larvae being destroyed in this way. A sufficient surplus of adults was accumulated from the F_2 and F_3 generations to allow for liberation of experimental colonies in the Niagara district [see preceding abstract].

MAXWELL (C. W. B.). Preliminary Experiments on the Control of the Cranberry Fruit Worm in New Brunswick.—Rep. ent. Soc. Ont. 71 (1940) pp. 47-50. Toronto, 1941.

An account is given of experiments in 1939-40 on the control of *Mineola vaccinii*, Riley, which is a serious pest of bog cranberry along the northern and eastern coasts of New Brunswick. In 1939, a dust of equal parts of synthetic cryolite and gypsum gave the best control. A derris spray gave significant control, but a derris dust and a spray of nicotine sulphate did not. The insecticides tested in 1940

comprised a spray of nicotine sulphate and Bordeaux mixture and dusts of undiluted natural cryolite, undiluted synthetic cryolite and sulphur and natural cryolite (7 : 3). All treatments gave significant control, but the only one that was significantly superior to the others was synthetic cryolite.

BROWN (A. W. A.). **A Note on the Gross Estimate of Forest Insect Damage in Canada.** [Abstract.]—*Rep. ent. Soc. Ont.* **71** (1940) p. 52. Toronto, 1941.

It is stated that the essentials required to obtain an approximate estimate of forest insect damage in Canada are maps showing the extent and intensity of the infestation, which can be derived from the data obtained by field laboratories and the Forest Insect Survey; an estimate of the volumes of the various tree species over unit areas, which are available in forest inventories; and sample plots in the area of infestation, which should be about 0.1 acre in size and reflect the various conditions on the spot. On this basis, the author has calculated figures for loss from tree mortality due to 11 of the more destructive species. This damage being cumulative, it is necessary to estimate the total mortality since the infestation began, and then to derive the annual figure by subtraction of the previous year's figure or by arbitrary estimate. Using these figures, he estimates that the total damage by these species in 1939 amounted to 2,680,800 cords, or 300 million cubic feet. The losses in thousands of cords attributed to the most important are 981 for *Agrilus anxius*, Gory, on birch, 452 for *Harmoloba* (*Cacoecia*) *fumiferana*, Clem. [on spruce and *Abies balsamea*], 700 for the biological strain of this Tortricid that attacks jack pine [*Pinus banksiana*], and 385 for *Gilpinia polytoma*, Htg., on spruce. It is considered that the total annual insect damage, including all species and taking loss of increment into account, may be from 600 to 700 million cubic feet.

HADDOW (W. R.). **Needle Blight and Late Fall Browning of Red Pine (*Pinus resinosa* Ait.) caused by a Gall Midge (Cecidomyiidae) and the Fungus *Pullularia pullulans* (de Bary) Berkhout.**—*Trans. R. Canad. Inst.* **23** pt. 2 pp. 161–192, 4 pls., 46 refs. Toronto, 1941.

Since 1932, plantations of red pine (*Pinus resinosa*), 5–25 years old, in southern Ontario have suffered intermittently from two maladies of the current season's foliage, needle blight, which affects the lower part of the needles, causing them to become hooked and to drop, and late fall browning, which occurs later in the season and is characterised by a browning of the whole plantation as if by fire. The resulting defoliation would undoubtedly kill the trees if it occurred in several successive seasons. These affections are compared with analogous ones in Europe and the United States, which have been associated with infestation by Cecidomyiids, and a detailed account is given of investigations on their aetiology. Both types of injury were associated with infestation by an unidentified Cecidomyiid, the female and larva of which are described, and which is closely related to *Thecodiplosis piniradiatae*, Snow & Mills, and *T. brachyntera*, Schwaeg. It was found to have one generation a year. The adults emerge from the soil in spring or early summer and oviposit in the sheath of scales at the

base of the needles. The larvae hatch in July and form cavities at the base of the needles. In October or later, they drop to the ground and pupate near the top of the mineral soil. The pupae overwinter.

Late fall browning was found to be due directly to injury by the larvae, but needle blight was caused by invasion of the bases of the shoots by *Pullularia pullulans*, which is commonly present on the sheath scales. The identity, systematic position and development of this fungus are discussed. The circumstances leading in nature to invasion by *P. pullulans* are not known, but the evidence indicates that infestation by the Cecidomyiid provides favourable conditions for it, although the larva is apparently killed while quite small in the process of development of the lesion.

The absence of mortality among the trees at one locality in which the Cecidomyiid has been known to be present for eight years is attributed to effective control of the midge by insect parasites. Those obtained were *Platygaster filicornis*, Ashm., which was undoubtedly a primary parasite, and a species of *Inostemma*, tentatively identified as *I. lintneri*, Ashm., which was reared from needles from a tree affected with fall browning. *P. filicornis* is the commoner in the field. The adults emerge from the soil at about the same time as the midges, oviposit in early June and were taken as late as mid-July in 1939.

MORTIMER (M. F.). **The Life History and Control of the Pine Tip Moth, *Rhyacionia frustrana* (Comstock), (Family : Tortricidae) at Nashville, Tennessee.**—*J. Tenn. Acad. Sci.* **16** no. 2 pp. 190-206, 28 figs., 12 refs. Nashville, Tenn., 1941.

Observations were made in 1936 on the bionomics and control of *Rhyacionia frustrana*, Comst. [cf. *R.A.E.*, A **18** 392] on nursery stock of *Pinus taeda* in Tennessee, and all stages of this Tortricid are briefly described. Infestation was severe during the spring and summer. After the buds have been destroyed by the larvae, adventitious shoots appear immediately below them, causing a condition known as spike-top that results in stooling of the branches, stunting, and in some cases the death of the tree. Random sampling in early spring on 20 trees that averaged about 34 ins. in height showed that 83.3 per cent. of the buds had been destroyed in the previous year, probably as a result of attack by larvae of all the generations.

There were three generations in the year. Eggs were deposited singly on the young pine needles or occasionally in the leaf axils, on the tips of dead needles near new growth, or in pairs on the shoot. The first-instar larvae fed on the surface tissues of the young shoots under a protective web covered with resin and situated near the tip. Second-instar larvae webbed together one or more buds, or buds and adjoining needles, and tunnelled into the shoot. Small tips were consumed in a few days, and the larvae then migrated to an adjoining bud or tip or more rarely to one in another cluster. From one to five larvae occurred in a single shoot, and the larval stage lasted 21-31 days. Only two instars were observed, but it is considered that there may be a third within the shoot. Pupation takes place within the terminal shoot, and the adults are active during the evening. In 1936, adults from the overwintered pupae were observed from 23rd March until 4th April, and oviposited from 25th March. Larvae of the first generation were present from 25th April to 14th May, and the adults from 25th May to 8th June, oviposition beginning on 28th May. The corresponding dates

for the second generation were 12th June to 12th July, 23rd July to 3rd August, and 25th July. The third-generation larvae were active from 3rd to 17th August, when they pupated and entered hibernation.

In tests of insecticides applied four times, on 12th, 20th and 30th April and 9th May, against first-generation larvae, a spray containing 26 oz. lead arsenate in an emulsion of $1\frac{1}{2}$ U.S. pints fish oil, 3 lb. soap and 50 U.S. gals. water gave 87.4 per cent. control and was more effective than sprays of lime-sulphur, Bordeaux mixture, kerosene emulsion, nicotine sulphate or lead arsenate alone or in a summer oil emulsion. In further trials with lead arsenate in fish-oil emulsions, applications were made on 26th and 30th May and 6th June, against the second-generation larvae. The same spray and one containing $2\frac{1}{4}$ U.S. pints fish oil both gave about 90 per cent. control and caused little injury to the foliage. A higher concentration of fish oil resulted in better control but more serious scorching.

ADAMS (L. E.). **Spring Cankerworm Investigations in Missouri.** (Abstract.)—*Proc. Mo. Acad. Sci.* 6 no. 4 pp. 78-79. Columbia, Mo., 1941.

Infestation by *Paleacrita vernata*, Peck, has increased in Missouri of recent years [*cf. R.A.E.*, A 28 517], and in 1939 many American elms [*Ulmus americana*] were completely defoliated by this Geometrid at Columbia. In 1940, the outbreak was the most severe since that of 1870-75. Experiments on banding the trees to prevent the ovipositing females from ascending the trunks were begun in February 1939. All the experimental trees were protected with commercial adhesive bands, and ribbons of fly-paper were applied to the smoothed bark below these on five of them. The fly-paper was effective for a short time, but dried out rapidly. Eight of the experimental trees were banded with cotton covered with thin sheets of cellophane [*cf. loc. cit.*], which were estimated to have prevented 26 per cent. of the males and 21 per cent. of the females from reaching the adhesive bands above and were also effective in trapping tiny larvae hatching from eggs laid in the cotton. Examination of the trees banded with adhesive alone showed that the peak of emergence occurred on 18th March, the first moths being caught on 27th February and the last on 19th April. Emergence apparently ceased when soil temperature fell below 35-40°F. The numbers of eggs found in 24 dissected females averaged 281.7 and ranged from 137 to 443. The average number laid by females in the laboratory was 111.5. The eggs hatched in 33-34 days on a west window sill, and in 29-33 days on apple trees in the field.

STONE (M. W.). **Life History of the Sugar-beet Wireworm in Southern California.**—*Tech. Bull. U. S. Dep. Agric.* no. 744, 87 pp., 30 figs., 9 refs. Washington, D.C., 1941.

The following is based on the author's summary of this detailed account of investigations in 1929-35 on the bionomics of *Pheletes* (*Limonium*) *californicus*, Mannh., in southern California. This Elaterid is distributed throughout the irrigated areas of the Pacific coast of the United States, and the larvae cause severe injury to sugar-beet, lima beans, potato, and many other vegetable crops. The injury, which may begin as early as February, continues throughout the spring, and even during the summer in fields under irrigation. With a decline in soil temperature in the autumn, the larvae resume activity, with

resultant damage to crops as late as October. Dissemination is mainly by flight, though winds may assist in carrying the adults over considerable distances.

When the top soil was moist, 50 per cent. of the eggs were laid in the first inch, but when it was low in moisture, most of the eggs were laid at depths of $2\frac{1}{2}$ –4 ins. The average incubation period varied from 35.1 to 27.2 days, for eggs deposited in February and May, respectively. Eggs hatched over a period of 77 days, from 23rd March until 8th June. There was no difference in the rate of development of larvae fed on lima beans, maize or wheat. A group of larvae existed on a monthly diet of 1 kernel of wheat each for a period of four years. When some of them were transferred to a diet of 8 kernels of wheat in the fourth spring, all had pupated by the autumn, whereas most of those that continued on 1 kernel per month were still in the larval stage in the next year. Of larvae reared in salve cans on various kinds and quantities of food, the percentages that matured in the first, second, third, fourth and fifth years were 4.1, 80.7, 13.8, 1.2 and 0.2. In outdoor cages, 4.5 per cent. matured in a 1-year cycle, 13.7 per cent. in a 2-year cycle, and 0.7 per cent. in a 3-year cycle; the rest were either killed by the survivors or died from natural causes or injuries received when handled. No significant relation existed between the length of larvae and the time of pupation, nor can their length be used to estimate their age. The prepupal and pupal stages averaged 7.6 and 21.4 days. The earliest pupation in salve cans occurred on 13th June, in 1934, and the latest on 27th October, in 1931 and 1933. The seasonal peak ranged in different years from 1st to 22nd September. The depth of pupation in outdoor cages averaged 10.5 ins. and ranged from 4 to 24 ins. If not disturbed by cultural practices, the adults remained in the pupal cells in the soil until December, when movement toward the surface began.

The beginning of adult emergence depends on soil temperatures during December and January. Low temperatures delayed the appearance of adults to 1st March, and high temperatures caused the earliest emergence (25th January). Emergence reached a peak in each year between 27th February and 19th March and ended on 2nd, 3rd or 4th April. Males were always more numerous during the first part of the emergence period. The percentage of females increased with the length of larval life, being 7.1, 48.7, 59.4, 66.7 and 100 for individuals developing in salve cans in 1, 2, 3, 4 and 5 years, and 32.2, 55.5 and 60 for those developing in outdoor cages in 1, 2, and 3 years.

The pre-oviposition period out of doors averaged 11 days, and the females deposited about 85 per cent. of their eggs in the first three weeks after oviposition began. Dormant adults exposed to 80°F. for a week mated and laid eggs 6 weeks before normal oviposition began in outdoor cages. Adults that emerged during March and were kept at 40°F. mated as soon as they were removed on 3rd September, and deposited fertile eggs. The average number of eggs laid for all years was 268.1 per female, and the average, maximum and minimum oviposition periods for all years were 31.2, 75 and 7 days. Males and females lived for averages of 29.8 and 46.2 days, the maxima being 91 and 81.

Natural enemies of importance in the field were birds, the Carabid, *Calosoma cancellatum*, Eschscholtz, which destroyed the adults, and particularly larvae of the Therevid, *Psilocephala frontalis*, Say, which were predacious on the larvae.

SNAPP (O. I.). **Insect Pests of the Peach in the Eastern States.**—*Fmrs' Bull. U. S. Dep. Agric.* no. 1861, 34 pp., 22 figs., 4 refs. Washington, D.C., 1941.

This bulletin is based largely on a previous one dealing with insects that attack peach in the southern United States [*R.A.E.*, A 16 636]. The information is brought up to date, and its scope extended to apply to most of the peach-growing areas east of the Rocky Mountains. Notes are given on the appearance, bionomics and control of some 18 pests, of which the most important are *Conotrachelus nenuphar*, Hbst., *Aegeria* (*Sanninoidea*) *exitiosa*, Say, *Aspidiotus perniciosus*, Comst., and *Cydia* (*Grapholitha*) *molesta*, Busck. These are dealt with in greater detail. Some of the insecticides commonly used on peach and spraying and dusting equipment are the subject of a concluding section.

JAYNES (H. A.) & BYNUM (E. K.). **Experiments with *Trichogramma minutum* Riley as a Control of the Sugarcane Borer in Louisiana.**—*Tech. Bull. U. S. Dep. Agric.* no. 743, 42 pp., 4 figs., 16 refs. Washington, D.C., 1941.

A detailed account is given of experiments carried out during 1933–35 in Louisiana showing the ineffectiveness of releasing large numbers of *Trichogramma minutum*, Riley, for the control of *Diatraea saccharalis*, F., on sugar-cane, a preliminary report of which has already been noticed [*cf. R.A.E.*, A 25 16]. The results obtained by other workers on the use of *Trichogramma* against various Lepidoptera in 1921–35 are briefly reviewed. In the course of investigations on the way in which the parasite passes the winter, several species of moths, none of which was identified, were observed depositing eggs at this time, and it is considered that these probably represent the winter and early spring hosts. The parasite dispersed as far as 100 ft. within 48 hours of release. Counts showed that the numbers of joints showing external injury and bored internally by *D. saccharalis* are well correlated. The results of the experiments on the release of the parasite are given in numerous tables and graphs, and since it was not associated with an increase in the yield of sugar [*cf. loc. cit.*], it is considered useless in Louisiana.

HIXSON (E.). **The Host Relation of the Cotton Flea Hopper.** [Abstract.]—*Iowa St. Coll. J. Sci.* 16 no. 1 pp. 66–68. Ames, Iowa, 1941.

Psallus seriatus, Reut., which is one of the most serious pests of cotton in the United States, is known to feed on plants of 138 species in 28 families. In Oklahoma, it occurs on plants of 87 species in 24 families, the most important being species of *Oenothera*, *Monarda*, *Solanum* and *Croton* [*cf. R.A.E.*, A 29 198]. The nymphs that hatch in spring from the overwintered eggs develop chiefly on *O. laciniata* and, in eastern Oklahoma, on *Ranunculus parviflorus*. The adults migrate in late spring and early summer to other plants, chiefly *Monarda* spp., *S. elaeagnifolium*, *Anthemis cotula* and *Croton texensis*. From July onwards, the preferred food-plants are species of *Croton*, on which most of the overwintering eggs are deposited. Infestation of cotton is initiated by adults moving from the late spring and early summer food-plants in search of their late summer and autumn food-plants, and its duration appears to depend on the rate of growth of the

cotton, the size of the field and the availability of species of *Croton*. The numbers of adults and nymphs on cotton are never so great as those on the preferred weeds. The Capsid can be controlled by proper land utilisation in which pastures are not over-grazed, terraces are either grassed or cultivated, and fields are properly cultivated. Species of *Croton* can be destroyed by mowing infested areas and encouraging the growth of grasses, with which they are unable to compete.

JONES (S. E.). **The Effect of Insect Control on the Yield and Quality of Cotton prematurely killed by Cotton Root Rot.** [Abstract.]—*Iowa St. Coll. J. Sci.* **16** no. 1 pp. 82–84. Ames, Iowa, 1941.

An account is given of investigations carried out in Texas in 1937–39, which showed that the low yield of cotton from plants killed by root rot before the first normal picking was not materially increased by controlling infestation by *Psallus seriatus*, Reut., and *Anthonomus grandis*, Boh. Control of the Capsid was effected by dusting with sulphur and of the weevil with calcium arsenate. If, however, the yield from the surviving plants in an affected field is sufficient for profitable cotton production and insects are damaging the crop, control measures should be applied against them.

MANIS (H. C.). **Bionomics and Morphology of the Black Onion Fly, *Tritoxa flexa* (Wied.) (Diptera, Ortalidae).** [Abstract.]—*Iowa St. Coll. J. Sci.* **16** no. 1 pp. 96–98. Ames, Iowa, 1941.

Descriptions are given of all stages of the Ortalid, *Tritoxa flexa*, Wied., which causes as much damage to onions in Iowa as *Hylemyia antiqua*, Mg., and is a potential pest throughout New England and the north-central United States. In these investigations on its bionomics, the adults were caged with growing onions and the larvae were reared individually in onion bulbs. The adults, which apparently feed on the nectar of flowers in the field, were given a mixture of malt, yeast, honey and water. In Iowa, the fly completes two generations and a partial third in the year, the first adults emerging in May. The pre-oviposition period and the egg, larval and pupal stages last about 14, 4, 24 and 14 days, respectively. The eggs are laid singly or in masses in the soil at the base of the plants or on the plant itself. The largest number laid by an individual female was 109. The larvae feed in the bulbs and usually pupate in the soil near them. Hibernation occurs chiefly in the larval stage in the bulbs, but some of the pupae also hibernate. The known food-plants are cultivated varieties of onions and chives, but it is considered that since the fly is indigenous, it must also feed on wild onions. Most of the damage in Iowa is caused to young seedling onions, several of which are destroyed by a single larva, and set onions are injured only if infestation is heavy. In such cases, only the tops and outer husks are left. The larvae were occasionally infested by an unidentified fungus, and many species of spiders are predacious on the adults.

SEIFERLE (E. J.). **A chemical Investigation of American *Veratrum*.** [Abstract.]—*Iowa St. Coll. J. Sci.* **16** no. 1 pp. 130–131, 16 refs. Ames, Iowa, 1941.

The rhizomes and roots of *Veratrum viride* (American hellebore) are used as a stomach poison against certain insects [*cf.* R.A.E.,

A 29 352]. In investigations on the separation of the components of the crude alkaloid mixture, five alkaloids were isolated in pure form. These were jervine and pseudojervine, which predominated (representing 17 and about 3.3 per cent., respectively, of the crude), rubijervine, which was present in small amounts, and protoveratridine and germine, which had not previously been isolated from *V. viride*. The toxic properties of many fractions separated, as well as of some of the pure alkaloids isolated, were tested by microinjection of solutions into *Periplaneta americana*, L. In this way, the progress of the fractionation procedures and the concentration of the toxic components by them were followed biologically. Jervine and pseudojervine were almost non-toxic to the cockroach, and the median lethal dose of germine was determined to be about 0.3 mg. per gm.

BECKWITH (C. S.). **Control of Cranberry Fruit Worm on Blueberries.**—*J. econ. Ent.* **34** no. 2 pp. 169–171. Menasha, Wis., 1941.

Mineola vaccinii, Riley, is an economic pest of cultivated blueberry in New Jersey, though it probably attacks less than 5 per cent. of the blueberries in the most seriously infested fields under observation, as the commercial value of the packed fruit is considerably reduced by the presence of living larvae. No damage is likely after the first picking of the earliest varieties. The overwintering cocoons have not been observed in blueberry fields, and it appears that a few adults that emerge early migrate into the fields each year, other food-plants, such as cranberries, being more attractive later. The moths are most numerous on cranberry in early July but were taken in a light-trap in blueberry fields as early as 20th May. The trap was operated for a month from this date, during which time 2–6 moths were caught on every clear evening; there was no indication of a large flight.

The newly hatched larva enters a berry at the stem end and eats the seeds and some of the pulp before entering a second, usually one in contact with the first; three or four berries may be destroyed before the larva matures. Larvae were found in the berries as early as 12th June; they were probably about 17 days old if the eggs hatched in five days as they do on cranberry. Hand-picking infested fruit a few days before harvest gave considerable control, but was not completely satisfactory. Fumigating the packed fruit with carbon bisulphide killed the larvae present, and dusting the fields from an aeroplane with 30 lb. per acre of a pyrethrum dust (10 per cent. Pyrocide [cf. *R.A.E.*, A 28 624]) on 29th May and again a week later reduced the number of larvae that left the harvested fruit by 94 per cent.

STONE (P. C.). **Maintaining live Chinch Bugs for Laboratory Use.**—*J. econ. Ent.* **34** no. 2 p. 179. Menasha, Wis., 1941.

Adults of *Blissus leucopterus*, Say, hibernate in Missouri in bunch-grass, which they choose presumably because there is adequate moisture and good protection at the base of the grasses throughout the hibernating period, and when they are taken to the laboratory during the winter, a high relative humidity and free moisture must be provided to

keep them alive. A cage, supplied with moisture by means of a wick, is described, in which the adults may be stored at a temperature of 35–55°F. for long periods or at 70°F. for over a month.

FELT (E. P.) & BROMLEY (S. W.). **Major Shade Tree Insects of 1940.**—*J. econ. Ent.* **34** no. 2 pp. 180–181. Menasha, Wis., 1941.

Galerucella luteola, Müll. (*xanthomelaena*, Schr.) was exceptionally abundant and destructive in 1940 in the northeast of the United States on elms that had not been sprayed for a few years. Observations in early July on healthy elms in New Hampshire showed exceptionally severe and sudden infestations by *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., on individual trees or parts of trees, and similarly infested trees were found in Vermont. In each case, injury occurred in the neighbourhood of dead or dying trees, and the severity of the attack was probably due to the abundance of broken and weakened elms resulting from hurricane damage in September 1938 [cf. *R.A.E.*, A **27** 528]. In one locality, 90 per cent. of the elms were attacked, but probably less than 5 per cent. were seriously damaged. In July, extensive mines and large numbers of larvae were present; adults emerged from 29th July to 10th September. Predacious Clerids were associated with the infestation, but control measures were necessary. Elms in Massachusetts and Connecticut, where injured trees were probably disposed of more rapidly, were not affected.

Infestation by *Popillia japonica*, Newm., increased considerably in south-eastern New York and south-western Connecticut, and the adults caused serious local damage to the more favoured food-plants. Early and thorough spraying with lead arsenate gave good results, two applications being necessary where the beetles were extremely numerous. Repellent sprays were usually unsatisfactory because the deposits were washed off by rain, but rubber emulsions adhered well and repelled the beetles until the rubber film began to crack and crystallise, when slight feeding occurred on exposed areas of the leaves. The addition of small amounts of lead arsenate to rubber emulsion resulted in serious arsenical injury to foliage, as free arsenic was liberated owing to the high alkalinity of the spray mixture. *Malacosoma disstria*, Hb., has been very abundant and destructive to sugar maple [*Acer saccharum*] in parts of New York, New Hampshire and Vermont during the last few years. Trees that had been defoliated rarely developed sufficient functional leaves for the remainder of the season, and many of those that had been completely defoliated for two years in succession were killed. In some districts its parasite, *Sarcophaga aldrichi*, Parker, was so numerous in 1940 as to cause considerable annoyance. *Plagioderia versicolora*, Laich., is a serious pest of willow in the north-eastern States [cf. **29** 438]; the adults and larvae feed on the leaves continuously through most of the growing season, reducing the vitality of the trees and killing many unprotected ones. *Rhyacionia buoliana*, Schiff., has gradually increased in numbers on pine since it was checked by the cold winter of 1933–34, and is now locally abundant and destructive, particularly to ornamental trees; its increase in southern New England, New York and New Jersey has seriously affected the status of the red pine [*Pinus resinosa*] as a reforestation, water-shed or ornamental conifer.

FASSIG (W. W.) & PIERPONT (R. L.). **Potassium Soaps of a Wood Rosin and Rosin Residue as Spreaders for Nicotine, Derris and Pyrethrum in Horticultural Sprays.**—*J. econ. Ent.* **34** no. 2 pp. 200–202, 1 ref. Menasha, Wis., 1941.

The following is based on the authors' summary. Tests with potassium soap of FF wood resin and potassium soap of resin residue (both containing 60 per cent. actual soap) as spreaders for nicotine sulphate, acetone extract of derris and 20 : 1 alcoholic extract of pyrethrum, using potassium oleate soap (40 per cent. actual soap) as the standard for comparison, showed that combinations of nicotine with any of these soaps were more effective against *Aphis rumicis*, L., or *A. spiraecola*, Patch, than either nicotine alone or derris and pyrethrum in combination with the soaps or alone. The soaps of the resin and resin residue were as satisfactory spreaders for nicotine as the oleate, but the latter was a better spreader for derris than the others and decreased less in efficiency when its concentration was reduced. The addition of any of the soaps at concentrations of 1 : 100, 1 : 200 or 1 : 400 to pyrethrum extract at 1 : 800 did not appreciably affect its efficiency, but a decided reduction in percentage kill was recorded when the same concentrations of these soaps were used with pyrethrum at concentrations of 1 : 1,600 and 1 : 2,400. At all the concentrations tested, potassium oleate soap by itself was more toxic to both Aphids than the other soaps, which were apparently about equal in toxicity. Resin soaps are commonly used for the sizing of paper, and it is believed that potassium soap of FF wood resin could be made available for insecticidal purposes at a cost comparable with that of potassium oleate soap. The order of decreasing effectiveness of the toxic agent used alone was acetone extract of derris, nicotine sulphate and alcoholic extract of pyrethrum.

PEARCE (G. W.), AVENS (A. W.) & CHAPMAN (P. J.). **The Use of Petroleum Oils as Insecticides. I. Determination of the Amount of Oil deposited on Apple Bark in Dormant Spraying.**—*J. econ. Ent.* **34** no. 2 pp. 202–206, 2 figs., 2 refs. Menasha, Wis., 1941.

The following is the authors' summary. A method for determining the amount of petroleum oil deposited on apple bark by dormant sprays is described. Typical results obtained when the method is applied to field experiments are presented. On the basis of a large number of replicated analyses of samples taken from field tests it was determined that the probable error of a single determination is ± 5 per cent. A discussion of the errors involved in the method is given.

CHAPMAN (P. J.), PEARCE (G. W.) & AVENS (A. W.). **The Use of Petroleum Oils as Insecticides. II. Some Factors affecting the Amount of Oil deposited on Apple Bark in Dormant Spraying.**—*J. econ. Ent.* **34** no. 2 pp. 207–212, 3 figs., 5 refs. Menasha, Wis., 1941.

Detailed results are given of experiments carried out under orchard conditions in New York State in 1939–40 with petroleum oil at various concentrations and amounts per tree and with a number of different emulsions; these have already been noticed from a shorter account

[cf. *R.A.E.*, A 30 95]. All the factors named [*loc. cit.*] affected the amount of oil deposited on apple bark; where twice the quantity of spray needed to cover a tree thoroughly was applied, the oil deposit was increased by about 33 per cent. in most cases, but by nearly 60 per cent. when an emulsion prepared with triethanolamine oleate was used.

WHITE (R. T.). **Development of Milky Disease on Japanese Beetle Larvae under Field Conditions.**—*J. econ. Ent.* 34 no. 2 pp. 213–215, 3 refs. Menasha, Wis., 1941.

Data that are considered to represent the results that may generally be expected are given on the natural increase of the type A milky disease of the larvae of *Popillia japonica*, Newm., caused by *Bacillus popilliae*, and the consequent reduction of the larval population in turf. On a golf course in New Jersey, the percentages of larvae infected and (in brackets) the population per sq. ft. were 0.2 (36) early in May 1939, 18 (5) on 28th June, 19 (40) on 1st September, and 60 (5.4) on 29th June 1940. Beetles were ovipositing in the soil on 16th August 1939, when 8 per cent. of the first-instar larvae were already diseased. In a similar area in Maryland, the figures were 4 (37) on 24th August 1939, 19 (20) on 6th November, 2 (18) on 21st May 1940, 67 (6.3) on 17th June, 30.3 (14.3) on 20th August and 28 (10.8) on 4th September. Winter mortality was negligible in 1939–40, and infection decreased during the winter and spring, but increased rapidly as the soil temperature rose. Seagulls were feeding on larvae in heavily infested areas in April 1940 [cf. *R.A.E.*, A 29 125]. Moderate feeding by adults occurred in July and August, and oviposition was heavy. The presence of milky disease in the District of Columbia was first established in May 1936. In June 1940, 45 per cent. of all forms were infected at one point where the population averaged 1.8 immature stages per sq. ft., but the percentage infection was much lower at two other points where the larval populations were higher. The larvae were much more numerous in September than in June, and treatment with spore-impregnated dusts was begun in many areas.

DUTKY (S. R.). **Susceptibility of certain Scarabaeid Larvae to Infection by Type A Milky Disease.**—*J. econ. Ent.* 34 no. 2 pp. 215–216, 3 refs. Menasha, Wis., 1941.

The author summarises available data on the susceptibility of larvae of Lamellicorns other than *Popillia japonica*, Newm., to infection by *Bacillus popilliae*. The species that have been shown to be susceptible are *Anomala orientalis*, Waterh., *Aserica* (*Autoserica*) *castanea*, Arr., *Cyclocephala borealis*, Arr., *Lachnosterna* (*Phyllophaga*) *anxia*, Lec., *L. (P.) bipartita*, Horn., *L. (P.) ephialda*, Say, *L. (P.) fusca*, Fröl., *L. (P.) rugosa*, Melsh., *Strigoderma arboricola*, F., and *Strigoderma pygmaea*, F.; *C. borealis* was also found to be susceptible to infection by *B. lentimorbus* (type B milky disease). Natural infection by *B. popilliae* has been observed in the United States in larvae of *Anomala orientalis* and very occasionally in those of *Aserica castanea* and *C. borealis*. *Cotinis nitida*, L., and *Macrodactylus subspinosus*, F., did not show susceptibility.

DUTKY (S. R.). **Testing the possible Value of Milky Diseases for Control of Soil-inhabiting Larvae.**—*J. econ. Ent.* **34** no. 2 pp. 217–218. Menasha, Wis., 1941.

A brief account is given of laboratory methods employed to determine the effect of milky diseases caused by *Bacillus popilliae* and *B. lentimorbus* on soil-inhabiting larvae, and of field methods that have been used in work against *Popillia japonica*, Newm. The degree of susceptibility to infection is determined by injecting a suspension of the spores into the larvae, and controlled feeding tests are carried out with various larval stages to find the portion of the larval period in which infection by feeding can be accomplished. Field tests should be made by inoculating the soil with a spore-talc preparation [cf. *R.A.E.*, A **29** 125] in such a manner that the spores will be introduced at the approximate soil level of maximum larval activity, and periodically examining samples of larvae for evidence of disease. Fairly heavy dosages of material should be used first in areas with a high host population, and the minimum effective dosages determined later. Samples of about 100 larvae should be obtained from the plots at bi-weekly intervals, and evidence of infection in them should be confirmed by microscopic examination.

WHITTINGTON (F. B.) & BICKLEY (W. E.). **Observations on Japanese Beetle Traps.**—*J. econ. Ent.* **34** no. 2 pp. 219–220, 2 refs. Menasha, Wis., 1941.

The results are given of investigations in Maryland in 1940 on factors affecting the efficiency of the type of trap used in that State [cf. *R.A.E.*, A **28** 521 ; **29** 125] against the Japanese beetle [*Popillia japonica*, Newm.]. Comparison of orange, yellow and four mixtures of yellow and green indicated that traps painted yellow are the most effective, and variation in the height of the traps showed that those suspended at a height of 30 ins. caught more beetles than those at 42, 54 or 66 ins. Modifications of the colour of parts of the trap and certain variations in construction produced no significant difference in effectiveness.

BLISS (C. I.). **Statistical Problems in estimating Populations of Japanese Beetle Larvae.**—*J. econ. Ent.* **34** no. 2 pp. 221–232, 6 figs., 11 refs. Menasha, Wis., 1941.

The following is the author's summary. Data on the number of Japanese beetle larvae [*Popillia japonica*, Newm.] per square foot in four 50 by 50 ft. areas differing widely in their mean infestations have been examined statistically. Although departing significantly from the random distribution of the Poisson series, the variance could be stabilised sufficiently for use in the analysis of variance by transforming the number of larvae per unit to square roots. The additional variation introduced by successive enlargements in the area examined has been determined by subsampling techniques.

On the assumption that the larval distributions observed in the four untreated areas would not be changed in their statistical form by insecticidal treatments, different experimental designs have been tested by means of hypothetical or "dummy" experiments. These showed that in unreplicated large plots, treatment effects could not be distinguished from field heterogeneity, that replication and randomisation lead to unbiased estimates of treatment effects, and that

marked improvements in precision could be gained by suitable restrictions in design. The error in the percentage control is least when 50 to 90 per cent. of the larvae are killed and varies inversely with the square root of the number of larvae per plot, but for discriminating between different treatments the mean surviving populations in transformed units should be compared directly rather than after conversion to the percentage control. By sampling each plot both before and after treatment instead of only at the end of the experiment, the precision of treatment comparisons could be increased by 30 to 60 per cent. for the same number of unit counts. This improvement resulted from a reduction in both plot and sample variances, measured by subsampling, from which the most efficient allocation of counts could be estimated.

HAMILTON (C. C.). **Toxicity of Methyl Bromide to the Common Red Spider and to Greenhouse Roses.**—*J. econ. Ent.* **34** no. 2 pp. 232–237, 6 figs. Menasha, Wis., 1941.

The following is based on the author's summary. Experiments on fumigation with methyl bromide against *Tetranychus telarius*, L., on rose twigs show that if the lethal concentration (that giving complete mortality) at one temperature and one length of exposure is known, the lethal concentration for any other length of exposure at the same temperature can be calculated. At any one length of exposure, there is a definite relation between the temperature and the lethal concentration. As the temperature decreased from 80 to 50°F., the lethal concentration increased at an accelerated rate. Further data are needed, however, before this relation can be expressed mathematically. Experiments on the tolerance of six varieties of rose to fumigation show essentially the same relations between concentration, temperature and length of exposure as do the tests on *T. telarius*.

At 50°F., the concentration of methyl bromide tolerated by the plants is distinctly less than that lethal to the mite, but as the temperature increased from 50 to 70°F., the toxicity of methyl bromide to *T. telarius* increased more rapidly than the toxicity to the plants, and at the latter temperature, the lethal concentrations with exposures of 2–8 hours (approximately 16–4 oz. per 1,000 cu. ft.) were essentially the same as those tolerated by the plants.

LANGFORD (G. S.), WHITTINGTON (F. B.) & CORY (E. N.). **Additional Studies on the Value of Traps in Japanese Beetle Control.**—*J. econ. Ent.* **34** no. 2 pp. 237–239, 1 ref. Menasha, Wis., 1941.

Observations on the value of traps for the control of the Japanese beetle [*Popillia japonica*, Newm.] in Maryland, begun in 1939 in an area in which all the farmers were co-operating [cf. *R.A.E.*, A **29** 125] were continued in 1940 on 16 widely scattered farms selected without consideration of co-operation. It was found that 1,941 traps on 3,231 acres of land caught 27.5 per cent. of the estimated number of beetles produced in the area, higher catches being obtained where traps were used at the rate of 1 per acre. More than five times the estimated production of beetles was caught on an asparagus farm of 161 acres on which 250 traps were used. It was apparent that traps do not necessarily prevent movement if preferred food-plants are absent; that large numbers of beetles move into crops of preferred food-plants and damage them whether traps are present or not; and that traps near preferred foods catch more beetles than those near unattractive plants.

The value of using large numbers of traps for control requires further investigation, but 275 traps in a 25-acre asparagus field caught 920 U.S. gals. of beetles between 12th July and 16th August and damage to the asparagus was negligible.

DRIGGERS (B. F.). **Three Years' Survey and Liberation of Oriental Fruit Moth Parasites in Peach Orchards in northern New Jersey.**—*J. econ. Ent.* **34** no. 2 pp. 239–244, 7 refs. Menasha, Wis., 1941.

The following is substantially the author's summary. Surveys of parasitism of twig-feeding larvae of *Cydia* (*Grapholitha*) *molesta*, Busck, made in peach orchards in New Jersey from 1937 to 1940, confirmed the results of earlier surveys, in which it was found that *Macrocentrus ancylovorus*, Rohw., was the principal parasite in southern New Jersey but was scarce or absent in northern New Jersey [cf. *R.A.E.*, A **29** 130]. In 1938, however, it was the principal parasite in two orchards in northern New Jersey. Investigation revealed that adults had been liberated near these two orchards in 1931, and it is suggested that the parasites made their way there from the point of liberation. Liberations in 1939 in two widely northern separated orchards in which it had not been found previously were followed by a high degree of parasitism by it on second- and third-brood larvae, and a further liberation in a third orchard in 1940 was also followed by a considerable increase of the parasite and by its spread to other orchards, including one six miles away. Surveys in 1940 in the first two of these orchards showed that it had overwintered successfully and had increased so much that it was the principal parasite in them and in neighbouring orchards.

STEARNS (L. A.) & AMOS (J. M.). **Ten-year Record of Oriental Fruit Moth Parasitism in Delaware.**—*J. econ. Ent.* **34** no. 2 pp. 245–248, 1 fig., 7 refs. Menasha, Wis., 1941.

The following is based on the authors' summary. Data collected during 1931–40 on the parasites attacking *Cydia* (*Grapholitha*) *molesta*, Busck, on peach in Delaware show that parasitism of twig-feeding larvae was extremely high, averaging 61·9 per cent., and that consequently infestation of peach fruits has usually been very low, the losses rarely exceeding 10 per cent. [cf. *R.A.E.*, A **28** 571 ; **30** 38]. *Macrocentrus ancylovorus*, Rohw., was the only important parasite ; it was always present in sufficient abundance to control the host effectively and accounted for an average of 92·7 per cent. of the total parasitism recorded. None of the 27 other species recorded, a list of which is given, was ever recovered in appreciable numbers from *C. molesta*.

STEINER (H. M.) & WORTHLEY (H. N.). **The Plum Curculio Problem on Peach in Pennsylvania.**—*J. econ. Ent.* **34** no. 2 pp. 249–255, 6 figs., 2 refs. Menasha, Wis., 1941.

The following is based on the authors' summary. Preliminary investigations in 1939 and 1940 on the plum curculio [*Conotrachelus nenuphar*, Hbst.] on peach in Pennsylvania showed that adults were present in the orchard from the blossoming period until after harvest, with peaks of abundance of overwintered adults occurring near the petal-fall stage. In 1940, marked adults moved an average distance of 94 ft.

in 12 days after release, with a maximum flight of 671 ft. in 40 days across a sprayed orchard. Egg-laying progressed to a considerable extent before the sepal-fall stage, and small dropped fruits less than $\frac{5}{8}$ in. in length produced most of the mature larvae. All the larvae became full-fed between 9th June and 1st August. Sprays of cryolite and Dutox [barium fluosilicate and sodium fluo-aluminate], applied three times, were more effective than lead arsenate, but the injury to foliage and small fruits that occurred during an early wet period in 1940 suggests that they merit further trial only in combination with possible safeners. Acid lead arsenate safened with zinc sulphate and hydrated lime was only slightly more effective than either basic lead arsenate or cubé, and three applications did not greatly reduce the number of larvae that matured, as compared with those in unsprayed plots. The cumulative effects of injury by acid lead arsenate on the bark of bearing wood should receive further attention.

ROSENSTIEL (R. G.). **Oviposition of the Omnivorous Leaf-tier.**—*J. econ. Ent.* **34** no. 2 p. 255. Menasha, Wis., 1941.

The oviposition habits of *Cnephasia longana*, Haw., were observed by means of flashlights during the evenings of 20th–25th June 1940 on a farm in Oregon. The eggs were laid singly in crevices in fence posts, telephone poles and rough tree-bark, and on the sides of unpainted shingle buildings, when the air was calm and the temperature ranged from 56 to 58°F.

WORTHLEY (H. N.) & STEINER (H. M.). **Lead Arsenate "Dynamite" Codling Moth Sprays in Pennsylvania.**—*J. econ. Ent.* **34** no. 2 pp. 256–263, 6 refs. Menasha, Wis., 1941.

The results are given of field tests carried out in 1937–40 with inverted spray mixtures of lead arsenate and cryolite, the preparation of which is described, against larvae of *Cydia (Carpocapsa) pomonella*, L., on apple in Pennsylvania; some of the results have already been noticed [*R.A.E.*, A **28** 218; **29** 371]. In 1939, schedules consisting of two lead-arsenate cover sprays, the second of which was an inverted spray containing the usual quantity of lead arsenate (3 lb. per 100 U.S. gals.) or twice as much, and was applied on 8th or 10th June, were as effective as those of four ordinary cover sprays with the last on 1st July. In 1940, in a very heavily infested orchard, schedules with a second (final) spray of inverted lead arsenate (6 lb. per 100 U.S. gals.) on 12th June were as effective until 23rd July as one consisting of four complete ordinary applications and one to the top of the tree only, finishing 16th July, but left deposits too light to protect the fruit from late second-generation attack, with the result that about three times as many larvae were present at harvest as in fruit treated with the extended schedule. The schedule containing inverted cryolite as the second (final) spray was less effective than any of the others tested. It is concluded that inverted spray mixtures, which should contain twice the standard concentration of lead arsenate and be applied at two or three times the rate necessary to cause run-off from the foliage in the top centre of the tree, will give at least as good protection against attack by larvae of the first generation as the usual schedule of four or five cover sprays, when timed as the second of two cover sprays. Where a whole orchard is so treated and is not subject to reinfestation,

second-generation larvae will be scarce; where seasonal conditions favour the development of a large second generation and the orchard is subject to reinfestation, however, supplementary applications may be advisable in August.

The residues at harvest from the inverted mixtures were usually similar to those from ordinary sprays and, except in 1938, they were below the 1940 tolerance of 0.05 grain lead and 0.025 grain arsenic trioxide per lb. fruit. Neither spray injury nor control of apple scab appeared to be complicated by the use of these sprays. No fungicides were added to the inverted sprays, though an inverted spray containing Bordeaux mixture and lead arsenate was effective on single trees, and did not cause spray injury. Liquid lime-sulphur was used in all first cover sprays in 1939 and 1940, and in some cases a fungicidal spray was applied after the inverted spray. Successful schedules of inverted sprays saved about 20 per cent. of the cost of the usual schedule of four cover sprays.

GINSBURG (J. M.). **Experiments with Chemicals on Codling Moth Larvae in the Dormant Season.**—*J. econ. Ent.* **34** no. 2 pp. 263–268, 7 refs. Menasha, Wis., 1941.

Laboratory and orchard experiments with various organic chemicals for the control of hibernating larvae and pupae of the codling moth [*Cydia pomonella*, L.] on apple in New Jersey are described, and the results are given in tables. Preliminary tests showed that solutions of dichlorethyl ether, ethylene chlorhydrin, phenol and cresol in water were highly toxic to larvae in corrugated paper at concentrations of 0.5–1.5 per cent., but, when tested against hibernacula on bark, all but dichlorethyl ether failed to penetrate the cocoons, even in the presence of a wetting agent (sodium lauryl sulphate). Dichlorethyl ether gave complete mortality at concentrations of 0.75 per cent. or higher in the laboratory, but when tested as a spray in the orchard on the trunks and main limbs of several varieties of apple at concentrations of 0.75, 1 and 2 per cent. in water solutions and in combination with oil emulsion and other solvents, it failed to give satisfactory mortality, chiefly owing to lack of penetration. In laboratory experiments with a number of water-insoluble organic solvents and emulsions of them, orthodichlorobenzene was the most toxic, killing 75 per cent. of the larvae on bark at a concentration of 1 per cent., and kerosene, the cheapest solvent tested, gave complete mortality of larvae at concentrations of 19 per cent. or more. As a spray in the orchard, undiluted kerosene killed 95 and 73 per cent. of larvae and pupae, respectively, and an emulsion, diluted to contain 17 per cent. kerosene, killed almost as high a percentage of larvae but only 21 per cent. of the pupae. No injury resulted to the trees from kerosene spray mixtures applied in the early spring, but distinct injury occurred to the bark from concentrated kerosene sprays applied during the growing season.

HARMAN (S. W.) & GREENWOOD (D. E.). **Codling Moth Control Studies in 1940.**—*J. econ. Ent.* **34** no. 2 pp. 268–270, 2 refs. Menasha, Wis., 1941.

Experiments were carried out in New York in 1940 to determine whether the proportion of oil could be reduced in sprays of nicotine

sulphate or fixed nicotine and summer oil emulsion, which have been shown to be effective against the codling moth [*Cydia pomonella*, L.] on apple [cf. *R.A.E.*, A 29 128] since it is incompatible with sulphur sprays, liable to injure the plant or give the fruit a dull appearance, and relatively expensive. Laboratory tests with eggs in early spring having shown that certain highly refined oils (viscosity 60 secs., 95 per cent. unsulphonatable residue) retained much of their ovicidal value at concentrations as low as 0.25 per cent. oil, orchard tests were carried out in which sprays containing 2-5 pints oil per 100 gals. water with nicotine sulphate or fixed nicotine were compared with sprays containing fixed nicotine or lead arsenate without oil. All the sprays were applied five times at intervals of 7-10 days. The sprays containing oil were noticeably the more effective, and it appeared that a substantial reduction is possible in the amount of oil ordinarily used in summer sprays with little sacrifice in ovicidal efficiency. Numerous tests showed that apple varieties differed considerably in their susceptibility to injury caused by sulphur and oil, but the danger from oil sprays applied after sulphur treatments appeared to be directly proportional to the amount of sulphur residue on the foliage. No important injury developed on one variety on which sulphur was applied two weeks after summer oil. Close examination at intervals during the summer and at harvest showed that the fruit coloured well and was noticeably brighter in appearance on the plots treated with the more dilute sprays.

These sprays have also given very good control of *C. pomonella* on pears without injury to the trees. Only one or two applications in August are usually necessary on pears in western New York.

SCHOENE (W. J.). **Plant Food and Mealybug Injury.**—*J. econ. Ent.* 34 no. 2 pp. 271-274, 12 refs. Menasha, Wis., 1941.

Pseudococcus comstocki, Kuw., has been found on apple in Virginia since about 1922, but did not become a pest of this tree until 1934 [cf. *R.A.E.*, A 24 722]. Since then there have been isolated outbreaks in a number of mature orchards, and surveys carried out in November 1939 and in 1940 showed that injury was most severe in orchards that had been treated with nitrogenous fertilisers for a number of years [cf. 29 195], and that no damage had occurred on unfertilised trees, in orchards in which a complete fertiliser had always been used, or on young trees. Up to August 1940, injury by the mealybug had been reported from 24 orchards, 21 in Virginia and the others in Ohio, West Virginia and South Carolina. In one orchard, the mealybug population appeared to increase with the amount of nitrogenous fertiliser applied, and in another where injury occurred first in 1935 and applications of sodium nitrate were discontinued after 1937, there was practically no injury in 1939. Infestation did not appear to be affected by the addition of phosphate or by the use of cyanamide or sulphate of ammonia instead of sodium nitrate.

From these observations it appears that an excess of nitrogen over potash and phosphorus in the nutrition of the tree, which tends to prolong its growing season, delays the colouring of the fruit and, in extreme cases, affects the sugar content and the keeping quality of the fruit, also promotes a type of growth that is very favourable to *P. comstocki*.

PEPPER (B. B.) & GARRISON (C. S.). **The Performance of Hybrid Field Corns under European Corn Borer Conditions in New Jersey.**—*J. econ. Ent.* **34** no. 2 pp. 281–284, 6 refs. Menasha, Wis., 1941.

Comparisons of the population of the European corn borer [*Pyrausta nubilalis*, Hb.] on eight hybrids and standard varieties of field maize at harvest in New Jersey in 1938–40 showed a definite correlation between stem hardness and population, though one relatively susceptible hybrid with a large stalk was able to tolerate a certain number of borers without a marked reduction in yield.

TURNER (N.). **A Large-scale Test of Dusts to control the European Corn Borer.**—*J. econ. Ent.* **34** no. 2 pp. 284–287, 3 refs. Menasha, Wis., 1941.

A large-scale field experiment was carried out in Connecticut in 1940 with commercial dusts of derris (1 per cent. rotenone) and dual-fixed nicotine (4 per cent. nicotine) for the control of *Pyrausta nubilalis*, Hb., on early sweet maize, to obtain information on the cost of treatment and the commercial value of treated cobs. Eggs of *P. nubilalis* were found on 3rd June, the first hatched egg-masses were observed on 10th June, and the plants were treated four times at intervals of approximately five days from 11th June. The methods of applying the dust and harvesting and sorting the ears are described, and details are given of the cost of treatment and the prices obtained. The percentage of uninfested ears decreased in each successive picking, probably owing to increased migration of larvae from the stalks. It was found that although the total yield and value of ears from the rotenone plot were greater than those from the nicotine plot, the nicotine dust gave a larger number and much higher proportion of uninfested ears, and in spite of the lower cost per acre of the rotenone dust, it is considered that the nicotine is distinctly preferable. The infested maize from the treated plots was much less injured than infested maize from untreated fields, which was unsaleable, and substantial profits were made in spite of the relatively high cost of treatment.

NASH (K. B.) & RAWLINS (W. A.). **Wireworm Studies in several Potato Rotation Systems.**—*J. econ. Ent.* **34** no. 2 pp. 287–290, 4 refs. Menasha, Wis., 1941.

The following is based on the authors' summary. Three potato rotation projects have been in operation in widely separated areas of New York State since 1936, and two of them have provided data on the relation of rotations to tuber injury caused by *Agriotes mancus*, Say. Population studies indicated that this was one of the most abundant and injurious of the species found in the plots in Steuben and Franklin Counties. Many larvae of *Hypnus* (*Cryptohypnus*) *abbreviatus*, Say, were found in the plots in Franklin County, but they apparently cause very little if any tuber injury. In both counties, a long rotation in which potatoes followed two years of sod had significantly the highest percentage of tubers injured by wireworm and the most severe injury to each tuber. In all cases, the amount of wireworm injury was consistently low where potatoes were grown continuously. In both counties, the modification of the long rotation by using a one-year

buffer crop, such as field beans or soy beans, between sod and potato, although reducing injury, was not so effective a control as the short rotations.

The yields were highest when potatoes were grown continuously and fertilised with barnyard manure, and almost as good when they were preceded by one year of clover-timothy seeding or two years of sod. The lowest yields were recorded from the rotations in which potatoes followed field beans or soy beans.

MORRILL jr. (A. W.). **Control of the Potato Flea Beetle on Shade-grown Tobacco in Connecticut.**—*J. econ. Ent.* **34** no. 2 pp. 291–295, 2 figs., 6 refs. Menasha, Wis., 1941.

Damage to tobacco in the Connecticut River Valley by *Epitrix cucumeris*, Harr., has been increasing for many years and was considered to represent 20–50 per cent. of the value of the crop by 1935. It was found that most of the infestation on tobacco originated from adjoining potato fields [*cf. R.A.E.*, A **30** 40]. Control experiments on shade-grown cigar-wrapper tobacco were carried out with a number of sprays and dusts in 1936–40, applications being made once a week from early June until late July in 1936 and 1937, and twice a week in 1938–40. The effectiveness of the treatments was compared on the basis of counts of living flea-beetles on sample plants at intervals during the growing season and of classification of leaves from sample plants according to the injury apparent after they had been fermented. Injury was recorded both as total feeding and as injury to the areas from which the wrappers are taken. Sprays were unsatisfactory since they could not be properly applied late in the season without mechanical damage to the plants, and dusts of cryolite or barium fluosilicate or of cubé diluted with a brown clay (1 per cent. rotenone) gave adequate control but left unsightly residues on the cured leaves. The most satisfactory control was obtained with a mixture of cubé and sterilised tobacco dust (1 per cent. rotenone) and with an impregnated pyrethrum powder containing 0.5 per cent. adsorbed pyrethrins [*cf. loc. cit.*]. The former has been widely used since 1936, with the result that the loss caused by *E. cucumeris* has been reduced to 1–2 per cent. of the value of the crop.

BROOKS (J. W.) & ALLEN (T. C.). **Tests of certain insecticidal Dusts against the Striped Cucumber Beetle.**—*J. econ. Ent.* **34** no. 2 pp. 295–297, 1 ref. Menasha, Wis., 1941.

In the market garden regions of south-eastern Wisconsin, adults of *Diabrotica melanocephala*, F. (*vittata*, F.) frequently appear in large numbers and attack seedlings of cucumber, melon and squash, so that it is necessary to replant many of the fields. The losses are due chiefly to feeding on the stems and leaves, which often destroys the whole plant; destruction of entire plants by bacterial wilt, disseminated by the beetles, is rare. Since repellents and inorganic insecticides have not usually given satisfactory control in this region, field and laboratory tests were carried out with dusts in 1938–40, by methods that are described in some detail. In order of decreasing efficiency, these were 12 per cent. derris in sulphur (0.6 per cent. rotenone), 14 per cent. barium fluosilicate or synthetic cryolite (sodium fluoaluminat) in talc, and 20 per cent. calcium arsenate or 6 per cent. nicotine sulphate

in hydrated lime. Derris was less effective in equal parts of sulphur and either talc or hydrated lime, and even less so when the diluent was talc alone, but was still more effective than any other insecticide. Hydrated lime alone gave no control. The use of sulphur as a diluent thus appeared to improve the toxicity of derris, and dusts in which it was incorporated caused no injury to squash plants of the large Hubbard variety.

RAINWATER (C. F.) & BONDY (F. F.). **Combinations of Insecticides for Control of Boll Weevil and Cotton Leaf Aphid.**—*J. econ. Ent.* **34** no. 2 pp. 297–300, 4 refs. Menasha, Wis., 1941.

The following is based on the authors' summary. Experiments were carried out in South Carolina in 1939 to determine the relative effectiveness of several insecticidal dusts and combinations of them for the control of *Anthonomus grandis*, Boh., and *Aphis gossypii*, Glov., on cotton. Calcium arsenate, mixtures of equal parts of calcium arsenate and two fixed nicotine dusts, and barium fluosilicate with enough derris to give a rotenone content of 0.5 per cent. were significantly better than two of the three synthetic cryolites tested with or without the addition of derris for the control of *Anthonomus*, when based on average seasonal infestation. Yield records and boll counts did not show significant differences between treatments. The cryolites and barium fluosilicate were inferior to calcium arsenate in dusting qualities, but when used with derris were followed by Aphid populations of only 12 and 24 per cent. of those with calcium arsenate. Equal parts of calcium arsenate and fixed-nicotine dusts reduced the Aphid population to approximately 50 per cent. of that in the plots dusted with undiluted calcium arsenate. Equal parts of calcium arsenate and sulphur or of calcium arsenate and diatomaceous earth, with the addition of derris, gave satisfactory control of *Anthonomus* and kept the Aphid population equal to that in the control plots or below it [*cf. R.A.E., A 30 43*].

METCALF (R. L.) & KEARNS (C. W.). **The Toxicity and repellent Action of some Derivatives of Picramic Acid and of Toluenesulfonyl Chloride to the Greenhouse Leaf Tier.**—*J. econ. Ent.* **34** no. 2 pp. 306–309, 3 refs. Menasha, Wis., 1941.

The following is substantially the authors' summary. Twenty-seven organic chemical compounds, derivatives of toluenesulphonyl chloride and of picramic acid, were tested as stomach poisons for larvae of *Phlyctaenia rubigalis*, Gn. The compounds were evaluated from the relative areas eaten out of leaf disks dusted with accurately weighed amounts of pure chemical compounds in a modified Campbell dusting tower [*cf. R.A.E., A 18 311*]. Of the compounds tested, nine were more effective than acid lead arsenate, and the most toxic was *N,N*-dimethylpicramic acid. Several generalisations concerning the relationship of molecular structure to toxicity in this series of compounds are made.

SMITH (G. L.), SCALES (A. L.) & GAINES (R. C.). **Further Studies of various Insecticides against three Cotton Insects.**—*J. econ. Ent.* **34** no. 2 pp. 310–313, 3 refs. Menasha, Wis., 1941.

The following is based on the authors' summary. In cage tests carried out in Louisiana in 1939, several arsenicals and cryolites were

used as dusts against *Anthonomus grandis*, Boh., and *Alabama argillacea*, Hb., and derris, pyrethrum, sulphur and mixtures of calcium arsenate and sulphur against *Lygus oblineatus*, Say, all on cotton. With calcium arsenates that had been separated into fractions according to particle size, a positive correlation was shown between particle size, percentage of water-soluble arsenic pentoxide as determined by the New York method and net mortality of *Anthonomus* [cf. R.A.E., A 28 475, etc.]. Calcium arsenate was more effective against *Anthonomus* and *Alabama* than cryolite with or without wetting agents. Dicalcium arsenate gave better results than commercial calcium arsenates, calcium arsenate with sulphur or Paris green, or basic copper arsenate. The addition of wetting agents to calcium arsenate and to cryolite did not significantly affect mortality. Calcium carbonate and sulphur appeared to be better carriers for calcium arsenate than lime. Against adults of *L. oblineatus*, mixtures of calcium arsenate and sulphur caused a higher mortality than sulphur alone. There was no significant difference in effectiveness between derris and pyrethrum, but both were more effective than mixtures of calcium arsenate and sulphur.

BOYCE (A. M.) & BARTLETT (B. R.). **Lures for the Walnut Husk Fly.**—*J. econ. Ent.* 34 no. 2 p. 318, 3 refs. Menasha, Wis., 1941.

Control measures against *Rhagoletis suavis completa*, Cress., in southern California [cf. R.A.E., A 29 561] are usually begun on the susceptible varieties of walnuts as soon as a new locality is known to be infested, the optimum timing of treatments being based on data regarding emergence of the flies from the soil. This information was formerly obtained by the use of soil cages, which has certain disadvantages, but a bait has generally been used since 1939 with very satisfactory results.

Investigations begun in 1937 showed that open enamel pans with a capacity of 2 U.S. quarts and open glass containers of the same capacity but with slightly less evaporation surface caught more flies than the usual glass traps, the pans usually giving the best results. A bait containing about 5.3 per cent. casein and 3 per cent. sodium hydroxide in water was the best of a number tested in 1937–38; in 1939, it proved somewhat less attractive than baits containing $2\frac{1}{2}$ and 5 per cent. glycine (amino acetic acid) dissolved in water, which had not previously been used. The glycine appeared to be more attractive at the lower concentration. Extensive trials over a period of four weeks in 1940 showed that glycine was significantly more effective at 2 per cent. than at 4 per cent.; that the addition of 3 per cent. sodium hydroxide significantly increased the effectiveness of the 2 per cent. glycine solution; that the results obtained when water only was added to the partly evaporated glycine baits were significantly better than those obtained when freshly prepared glycine was substituted for the old material at weekly intervals; and that there was no significant difference between a bait of 2 per cent. glycine with sodium hydroxide kept at approximately constant volume by the addition of water and the standard bait of casein with sodium hydroxide refilled with fresh material at weekly intervals. Baits were most effective at the top of the tree and least effective in the lower portion, but the traps are usually placed in the central portion, for practical reasons. A bait containing 2 per cent. technical glycine and 3 per cent. commercial sodium hydroxide in water is considered to be the most promising of those tested.

JONES (G. D.). **A new Grape Insect in Missouri.**—*J. econ. Ent.* **34** no. 2 p. 321, 1 fig. Menasha, Wis., 1941.

In 1940, large numbers of adults of the Eumolpid, *Rhabdopterus praetexta*, Say, were found with those of the grape root worm [*Fidia viticida*, Walsh] in an unsprayed vineyard in Missouri, and were observed to be feeding on the young grapes in the clusters. Similar injury had been reported two years previously. Laboratory tests confirmed the observation that the beetles feed on the fruit and showed that adults of *F. viticida* would also do so, though they fed chiefly on the leaves.

In a note by H. S. Barber, it is stated that *R. praetexta* has commonly but erroneously been considered a synonym of *R. picipes*, Ol. The latter is peculiar to the Floridian fauna; its type-locality is probably in South Carolina, and some specimens from lower Maryland, North Carolina, Florida and Alabama appear to be referable to it. The frequent references in the literature to *R. picipes* as a pest of various wild and cultivated plants, including cranberry and grape, in much of the eastern United States, apply to *R. praetexta*, which differs in characters of the aedeagus and in colour from *R. picipes* and appears to inhabit the region from Maine to Texas.

SMITH (W. W.). **A new Leaf Roller on Strawberry.**—*J. econ. Ent.* **34** no. 2 p. 323, 2 refs. Menasha, Wis., 1941.

Observations near Logan, Missouri, in 1938–40 showed that strawberry leaves were rolled before the regular feeding period of the strawberry leaf-roller, *Ancyliis comptana*, Froel. (*fragariae*, Walsh & Ril.), and larvae collected on 16th April 1940 were found to be those of *Tortrix (Amelia) pallorana*, Rob., which has been recorded as a leaf-roller of rose in New Jersey and on the foliage of lucerne in Kansas [cf. *R.A.E.*, A **17** 362]. The strawberry leaves are rolled by 10th–15th April in ordinary seasons, and the adults begin to emerge about 18th May, and are fairly common in the beds throughout June and July. The larvae of *Ancyliis comptana* did not begin to hatch until 8th May in 1940 and damage by them was not evident until several days later. At present, the chief economic importance of *T. pallorana* lies not in the damage that it causes but in the fact that it misleads growers in the timing of sprays against *A. comptana*.

ISELY (D.). **Control of the Common Red Spider on Cotton.**—*J. econ. Ent.* **34** no. 2 pp. 323–324, 1 ref. Menasha, Wis., 1941.

An account is given of field tests with sulphur alone or mixed with 5 per cent. of a commercial dust containing 1 per cent. dinitro-orthocyclohexylphenol in walnut-shell flour against *Tetranychus telarius*, L., on cotton, carried out during an extensive outbreak that occurred in north-eastern Arkansas in the summer of 1940. The dusts were applied between 28th July and 7th August, when infestation was spreading. Since most infestations originated from woodland or banks adjacent to the cotton and a few from vegetation round stumps, the total area to be dusted was not great, and small dusters were used. Infestation was spread by cultivation and sometimes by the operation of dusting, and appeared to be more extensive where the plants were rank and had interlacing branches.

The percentages of previously infested leaves on which active mites were present within a week after dusting were 27·67 following the mixture and 84·57 following sulphur ; mites occurred on 98·83 per cent. of the injured leaves in the controls. There were very few mites per leaf in the first case and relatively few, compared with the control, in the second. Single applications of either dust checked the spread of the mite, though three were necessary to eradicate it in a few places ; eradication followed more readily where the mixture was used. No plant injury was caused by the dinitro-o-cyclohexylphenol at the concentration tested (0·05 per cent.). On other plantations on which sulphur was applied, the results were variable and the degree of control appeared to be proportional to the thoroughness of the application. Dusting from above had little value, particularly on rank cotton ; it was necessary that the infested foliage should be covered with the dust.

VENABLES (E. P.) & DENNYS (A. A.). **A new Method of counting Orchard Mites.**—*J. econ. Ent.* **34** no. 2 p. 324. Menasha, Wis., 1941.

A simplified method of estimating the populations of mites in orchard plots consists in placing sample leaves between two sheets of white mimeograph paper and passing the sheets between the rollers of an ordinary clothes wringer. The rollers should be of fairly soft rubber in order that mites beside the midrib and larger veins do not escape the pressure. The crushed mites leave characteristic stains on the paper ; those left by *Tetranychus pacificus*, McG., though paler than those from *Paratetranychus pilosus*, C. & F., are readily visible, so that even heavy infestations can be counted with a satisfactory degree of accuracy. Both sides of the leaves are represented in the impressions. Summer eggs of *P. pilosus* leave small orange-coloured impressions that can be distinguished fairly easily from those left by nymphs and adults, but those of *T. pacificus* do not leave clear impressions. Only small numbers of leaves should be collected at a time, as the mites tend to wander from picked samples, and leaves begin to curl about half an hour after collection.

WALKER (H. G.) & ANDERSON (L. D.). **Control of the Corn Earworm on Broccoli.**—*J. econ. Ent.* **34** no. 2 pp. 325–326, 1 ref. Menasha, Wis., 1941.

During the autumn of 1939, a heavy infestation of *Heliothis armigera*, Hb., developed on about 500 acres of broccoli, on the Eastern Shore of Virginia, that had been receiving weekly applications of a derris dust containing 0·75 per cent. rotenone, and preliminary tests were therefore carried out in one field with a number of dusts for its control. The dusts were applied at the rate of 20–25 lb. per acre on a calm morning when the plants were wet with dew. The plots were accidentally dusted with the derris 24 hours later, but this had no apparent effect on the larvae or on the results. Counts of the living larvae 72 hours after treatment showed that there were no significant differences in effectiveness between calcium arsenate alone, and with Paris green and hydrated lime (40 : 10 : 50) or hydrated lime (50 : 50), which gave 97, 84 and 81 per cent. control, respectively, but all were significantly

better than 80 per cent. barium fluosilicate or a pyrethrum dust (10 per cent. Dry Pyroicide [cf. *R.A.E.*, A 28 624]), which gave 53 and 44 per cent. control.

The entire crop was, therefore, dusted from an aeroplane with undiluted calcium arsenate, applied at the rate of about 25 lb. per acre when 5–10 per cent. of the plants were forming heads, and satisfactory control was obtained; it was necessary to wash broccoli that was harvested within 10 days of treatment to reduce the arsenical residue to within the legal tolerance.

KNOWLTON (G. F.). **Boxelder Bug feeding Habits.**—*J. econ. Ent.* **34** no. 2 p. 326. Menasha, Wis., 1941.

On 26th September 1935, large numbers of *Leptocoris trivittatus*, Say, were congregated on ripe and over-ripe plums, both on the tree and on the ground, in a locality in Utah, 731 being collected from 14 plums on the tree. In some cases, the Coreids were also abundant on the leaves. The ripe fruits on neighbouring apple trees and many of the fallen ones were conspicuously attacked, particularly if the skin was broken. Both nymphs and adults occurred on the fallen fruit, but only adults were found on the trees, though both stages have been observed to feed on ripe apples and pears on the tree.

[PONOMARENKO (D. A.). Пономаренко (Д. А.). **Insects injuring the irrigated and unwatered Lucerne in the Region of the left Bank of the Volga and the adjoining Regions.** [*In Russian.*].—*Bull. Plant Prot.* 1940 no. 1–2 pp. 24–38. Leningrad, 1940.

Observations over a number of years have shown that irrigated and non-irrigated lucerne in the south-east of European Russia is attacked in its various stages by about 70 species of insects. Notes are given on the parts of the plant attacked by them, their relative importance and the losses for which they are responsible. Some of the information is similar to that already noticed [cf. *R.A.E.*, A 22 587, 588; 26 76; 27 108].

Of those that infest lucerne in the year of sowing, the most important are the Elaterids, *Corymbites (Selatosomus) latus*, F., *Agriotes sputator*, L., and *A. gurgistanus*, Fald., and weevils of the genus *Sitona*, all of which injure the young sprouting plants, the Capsids, *Adelphocoris lineolatus*, Goeze [cf. 27 475] and *Poeciloscytus cognatus*, Fieb., which migrate from old lucerne and feed on the inflorescences of the young plants, and the Eurytomid, *Bruchophagus gibbus*, Boh., which infests the seeds. Second-year lucerne grown for seed is injured in spring by the larvae of the Cerambycid, *Plagionotus floralis*, Pall., which hollow out the heart of the main root to a depth of 4–6 ins. or more below the surface of the soil, the damage being particularly severe in non-irrigated fields. The roots are also attacked by the larvae of *Sitona longulus*, Gylh., and the root nodules by those of *S. callosus*, Gylh., *S. inops*, Gylh., and *S. cylindricollis*, Fhs. The leaves are injured by *Sitona* spp., *Eusomus ovulum*, Germ., *E. acuminatus*, Boh., the Aphids, *Macrosiphum onobrychis*, Boy. (*Acyrtosiphon pisi*, Kalt.) and *Myzocallis (Therioaphis) ononidis*, Kalt. (on irrigated and non-irrigated lucerne, respectively), the meadow moth [*Loxostege sticticalis*, L.] and the Noctuids, *Heliothis (Chloridea) dipsacea*, L., and *H. (Melicleptria) scutosa*, Schiff. The stems are infested in early

spring by *Hylemyia variata*, Fall., and later by *Apion tenue*, Kby., and *Cydia* (*Laspeyresia*) *caecana*, Schlaeger. The flower buds are destroyed by the Cecidomyiids, *Dasyneura* (*Perrisia*) *ignorata*, Wachtl., and *Contarinia medicaginis*, Kieff., both of which predominated in irrigated fields, and by the weevils, *Hypera* (*Phytonomus*) *transsylvanica*, Petri, and *Apion filirostre*, Kby. The pods are attacked chiefly by the weevils, *Tychius medicaginis*, Brisout, *T. flavus*, Beck., and *T. femoralis*, Brisout, and to a less extent by *T. junceus*, Reich, *B. gibbus* and *Cydia* (*L.*) *microgrammana*, Gn.

Irrigated lucerne that has been mown once for seed grows again at the end of July or the beginning of August and produces a good yield of hay in autumn. Under non-irrigated conditions, however, its growth is considerably retarded. At this period, the most important pests are the larvae of *Plagionotus floralis*, *Otiorrhynchus ligustici*, L., and *Sitona* spp., which attack the root system. The practice of mowing old lucerne for hay while it is flowering in the first half of June, and then irrigating it and allowing it to grow for seed prevents the development of a number of pests; some die or abandon the mown lucerne, and others have become less active by the time it is growing again. The most important are those that injure the seeds, especially *B. gibbus* and sometimes *T. junceus*, and to a less extent *T. flavus*, *T. femoralis* and *C. microgrammana*. *B. gibbus* becomes prevalent when lucerne crops of different dates of pod production are grown together, while infestation by *C. microgrammana* is serious only when lucerne is grown for seed in the same field for several consecutive years. Important damage is caused to the roots by *P. floralis* and *Sitona* spp.

Second-year lucerne that is grown exclusively for hay is comparatively little infested, as it is mown twice during the season in non-irrigated fields and three or four times in irrigated ones. Species that attack the roots and, in some instances, Aphids, may, however, become abundant.

[BOGUSH (P. P.).] **Борьба (П. П.). Poisoned Baits as a Control Measure against *Phytonomus*.** [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 39-41. Leningrad, 1940.

In Central Asia, where it is extensively cultivated, lucerne is severely attacked by *Hypera* (*Phytonomus*) [*variabilis*, Hbst.], which frequently almost completely destroys the first crop in early spring. Experiments were, therefore, carried out in Turkmenistan on the control of this weevil by means of poisoned baits of cottonseed meal. When adult weevils were placed in cages containing green lucerne plants, and the bait was strewn over the bottom, one poisoned with 3 per cent. Paris green gave 86 and 84 per cent. mortality in 4 and 8 days, respectively, and one containing 6 per cent. calcium arsenate killed 97 per cent. in 8 days. In field experiments against the larvae, in which baits of cottonseed meal and calcium arsenate were distributed by a dusting apparatus, the percentage mortality was 30-50 in 6 days, the best results being obtained when the bait was poisoned with 6 per cent. calcium arsenate and was applied at the rate of 45 lb. per acre. The application of this bait at the same rate two weeks later, when the larvae were more numerous, gave about 75 per cent. mortality in 6 days, and was effective against larvae in all instars. Baits are more economical than poison dusts, since much less of the poison is required per acre, and can safely be used on lucerne that is intended for fodder.

[PYATNITZKIĬ (G. K.).] Пятницкий (Г. К.). **New Methods of mechanical and chemical Control Measures against the Beet Weevil.** [In Russian.]-*Bull. Plant Prot.* 1940 no. 1-2 pp. 42-46. Leningrad, 1940.

Investigations in the Province of Kirovograd have shown that the comparative ineffectiveness of the measures hitherto taken for the control of *Cleonus punctiventris*, Germ., on beet has been due to the neglect of old beet fields, from which the weevils emerge after protracted dormancy [cf. *R.A.E.*, A 29 577, etc.], to insufficiently close spacing of the network of shallow trap ditches [cf. 29 578], and to the large numbers of weevils that escape from the deep ditches along the edges of the fields when collection by hand is carried out by insufficient numbers of workers. Control can be greatly improved by measures based on the results of recent experiments [30 68-70].

[SAVCHENKO (E. N.) & YARMOLENKO (I. M.).] Савченко (Е. Н.) и Ярмоленко (И. М.). **The Bonification of Chloropicrin and the Mechanisation of its Introduction into the Soil during the Application of Control Measures against the Larvae of the Beet Weevil.** [In Russian.]-*Bull. Plant Prot.* 1940 no. 1-2 pp. 53-61, 13 refs. Leningrad, 1940.

This further account of experiments in the Province of Kiev already noticed [*R.A.E.*, A 26 236] on soil fumigation against *Cleonus punctiventris*, Germ., deals particularly with the increase in the effectiveness of chloropicrin obtained by the addition to it of paradichlorobenzene, naphthalene, crude anthracene or used lubricating oil (which was most effective when mixed in the proportion of 1 : 5 by volume). The effect of these substances is explained by the fact that they have higher boiling points than chloropicrin and so delay its evaporation. Moreover, the three aromatic hydrocarbons themselves act as fumigants. The effect of the mixtures on the beet plants was as detrimental as that of chloropicrin alone, an average of 70-80 per cent. of the roots being scorched in all experiments. Fumigation should, therefore, be carried out only before sowing or after harvest. Brief descriptions are given of appliances designed and constructed in Russia for introducing chloropicrin into the soil.

[ANDREEVA (N. V.).] Андреева (Н. В.). **Effect of Injuries caused by the Beet Flea (*Chaetocnema concinna*) on the Growth and Yield of Beets.** [In Russian.]-*Bull. Plant Prot.* 1940 no. 1-2 pp. 62-68. Leningrad, 1940.

In view of the serious losses in the yield of beet in western Siberia resulting from infestation by the Halticid, *Chaetocnema concinna*, Marsh., laboratory and field investigations were carried out in 1935 and 1936 to determine the extent of the injury caused. It was found that the percentage of young seedlings killed was in direct proportion to the number of the insects on them and the intensity of the feeding, and in inverse proportion to the age of the plants and the size of the cotyledons. There was no relation, however, between the number of plants destroyed and the duration of the feeding of the flea-beetles, which indicated that the protective reaction of the plants to infestation depends chiefly on ecological conditions. The roots of plants on which 50 and 75 per cent. of the surface of the cotyledons had been destroyed weighed only 70 and 47 per cent. as much as those of undamaged plants.

[VASIL'EV (I. V.).] Васильев (И. В.). A brief Review of Control Measures against Corn Bugs. [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 69-71. Leningrad, 1940.

This is a brief review of methods that have been recommended in the literature for the control of Pentatomid bugs on cereals; the species of importance in the Russian Union are *Eurygaster integriceps*, Put., *E. maura*, L., *E. austriaca*, Schr., *Aelia acuminata*, L., *A. rostrata*, Boh., *Dolycoris baccarum*, L., *Carpocoris pudicus fuscispinus*, Boh., and *Palomena prasina*, L.

[VEL'TISHCHEV (P. A.).] Вельтищев (П. А.). Pests of subtropical Cultures and Control Measures against them in Taluish (Azerbaijan). [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 72-77, 4 refs. Leningrad, 1940.

The extensive cultivation of sub-tropical plants in south-eastern Azerbaijan (region of Taluish) has provided favourable conditions for the development of a number of pests. A survey of them is given, with notes on their economic importance, and brief suggestions for the control of some of them. Those that have been introduced comprise *Paratetranychus citri*, McG., and several Coccids on *Citrus* and *Toxoptera aurantii*, Boy., and *Parlatoria* (*Syngenaspis*) *theae*, Ckll., on tea, but the only ones at present abundant enough to be injurious are *Coccus hesperidum*, L., which is resistant to the local rapid changes in temperature and humidity and causes considerable damage to *Citrus* in the open, and *Paratetranychus citri*, which is chiefly of importance in nurseries.

The indigenous insects that have become injurious are more numerous. The adults of the Cetoniids, *Epicometis hirta*, Poda, and *Oxythyrea cinctella*, Schaum, destroy the flowers of *Citrus* and tung [*Aleurites*] early in May. *Isophya stshelkanovzevi*, Miram, and *Poecilimon riabovi*, Uvarov, feed on the leaves, flowers and flower-stalks of *Citrus*, tea and *Aleurites* on terraces in the mountains, but both disappear by the middle of July. Another, but less injurious, Tettigoniid is an undescribed species of *Paradrymadusa* that feeds on the young bark of woody undergrowth and sometimes kills tea slips by gnawing them through. All the sub-tropical plants are attacked by Acridids, of which *Calliptamus italicus*, L., *Aiolopus thalassinus*, F., and *A. strepens*, Latr., are the most important. *Calliptamus* feeds chiefly on mandarin oranges and persimmon [*Diospyros kaki*] on the slopes of the mountains, and *A. thalassinus* on the young leaves of tea in the low-lying districts. The Prionid, *Parandra caspia*, Ménétr., which normally tunnels in the trunks of mature chestnut oaks (*Quercus castaneaeifolia*), has sometimes been found in the stems of *Aleurites* 3-4 years old. It is usually accompanied by *Crematogaster scutellaris schmidtii*, Mayr, which is widely distributed in the region, and colonies of this ant have been found beneath the bark and the lower part of the trunks of infested *Aleurites*. Many of the immature nuts of *Aleurites* drop as a result of infestation of the flower stems by the Pentatomid, *Apodiphys amygdali*, Germ., and the leaves in one locality were attacked in August-September by *Taeniothrips* spp., chiefly *T. frici*, Uzel, which cause them to fall. When weeds are allowed to grow in tea plantations until midsummer to give shade to the seedlings, the adults of *Cassida nebulosa*, L., which breeds on *Chenopodium album*, migrate to the tea after weeding in mid-June and seriously injure the young leaves. The

stems are damaged by the Cixiid, *Hyalesthes mlokosjevici*, Sign., which migrates from neighbouring wild elder (*Sambucus ebulus*) and can be caught in large numbers in light-traps.

A spray containing an extract (known as Lapin) of the leaves of *Pterocarya caucasica* (*fraxinifolia*), which is common in Transcaucasia and the Crimea, has given satisfactory control of all stages (including eggs) of *Paratetranychus citri* on *Citrus* and has also proved effective against *Taeniothrips* on *Aleurites*. The leaves are stirred for 2-3 hours in 10 times their weight of boiling water; the extract is then filtered and diluted with 10 parts water. The active principle is a saponin. The spray can also be prepared with dried leaves of *P. caucasica*, but in this case only half the usual amount of water should be used for extraction.

[BOBINSKAYA (S. G.).] **Бобинская (С. Г.). Basic ecological Factors regulating the Increase of *Polychrosis botrana* Schiff. in Kakheta.** [In Russian.]-*Bull. Plant Prot.* 1940 no. 1-2 pp. 78-86, 1 graph, 10 refs. Leningrad, 1940.

Polychrosis botrana, Schiff., has three generations a year on vines in Kakheta (eastern Georgia), but is not a serious pest except in one locality on the right bank of the river Alazan. Laboratory and field investigations on the factors governing its distribution were, therefore, carried out there in 1934.

Emergence from the overwintered pupae begins when the mean day-and-night temperature reaches 12°C. [53.6°F.], irrespective of humidity and the position of the pupae on the stems of the vines. The moths fly in the morning and evening at temperatures between 15 and 30.9°C. [59-87.62°F.], activity being greatest at 20-27°C. [68-80.6°F.]. The duration and intensity of the flight depend on temperature and precipitation; in 1934, the adults of the overwintered, first and second generations appeared on 28th April, 1st July and 5th August, respectively, and were present for 41, 23 and 38 days, the mean daily temperatures during these periods being 14-24, 20-27 and 15-26°C. [57.2-75.2, 68-80.6 and 59-78.8°F.]. The weather was rainy during the first flight, but dry in July. At relative humidities of 10-100 per cent., the moths lived longest (12-13 days) at 20°C.; at 25, 30 and 35-40°C. [77, 86 and 95-104°F.], they survived for only 10-11, 8 and 2 days, respectively. The greatest number of eggs was laid at 20-25°C. and 60-64 per cent. relative humidity; at all other humidities, egg maturation was retarded. The average numbers laid at the optimum temperature by females that were given water only, a 6 per cent. solution of fruit syrup, flower nectar or grapes were 25, 7.7, 10.3 and 7.3 respectively, and the eggs matured most rapidly in the first case. The fat-body was exhausted in all females after oviposition, and it is concluded that the number of eggs deposited depends on the degree of development of the fat-body in the newly emerged moth.

The eggs hatched in 3-4½ days at 20-25°C. and 57-85 per cent. relative humidity, and though development was quicker at higher temperatures, irrespective of humidity, mortality increased. No eggs survived at above 40°C. [104°F.]. In the field, eggs were killed after being exposed to the sun for one hour at 38-40°C., and insolation is, thus, an important factor affecting the number of larvae that hatch. The duration of the larval and pupal stages depended on temperature; at 10-100 per cent. relative humidity, and 20, 25 or 30°C., the larval

stage lasted 31, 28 and 24 days, and the pupal stage 11–12, 9–10½ and 7½–9 days, respectively. The optimum apparently occurs at 25–30°C. In the field, however, the temperature usually fluctuates considerably, larval development is protracted and the generations overlap. At 30°C. the percentage of pupae that gave rise to adults decreased as conditions became drier; at 35°C. emergence took place only at a humidity of 100 per cent., and at 40°C. no moths appeared. These data were confirmed by field observations.

It is concluded that the optimum conditions for the development of *P. botrana* are a temperature of 25–27°C. and a relative humidity of 60–64 per cent., under which conditions the life-cycle is completed in 37½–40 days and the rate of survival is greatest. About 50–60 per cent. of the eggs are killed by the sun, and about 60–70 per cent. of the larvae give rise to adults. The diversity of microclimate in Kakheta accounts for the difference in economic importance of *P. botrana* in different parts of the region.

[SHEK (G.) & ABDULLAEV (A.).] Шек (Г.) и Абдуллаев (А.). The Fecundity of the Transcaucasian Marble Coccothraupis, *Polyphylla olivieri* L. in Connection with Nutrition. [In Russian.]—Bull. Plant Prot. 1940 no. 1–2 p. 87. Leningrad, 1940.

As the adults of *Polyphylla olivieri*, Lap., feed in numbers on cypress [*Cupressus*] in Azerbaijan [cf. R.A.E., A 21 10], experiments were carried out in Kirovobad to determine the effect of the food-plant on their fertility. Of three batches of 6 females reared in the laboratory and caged with 6 males, all were given access to water and two were allowed to feed, one on cypress and the other on vine leaves. Counts of the eggs deposited and found in the females on dissection showed that the average totals per female were 27 for those given cypress, 25.7 for those given vine leaves, and 15.7 for those without food.

[SHEK (G. Kh.).] Шек (Г. Х.). The Cause of the Mass Increase of *Pseudococcus citri* Risso in Azerbaijan. [In Russian.]—Bull. Plant Prot. 1940 no. 1–2 pp. 88–90, 7 refs. Leningrad, 1940.

Fedorov's view that a dry summer prevents an outbreak of *Pseudococcus citri*, Risso, on vines in Azerbaijan [cf. R.A.E., A 24 704] was not supported by observations in 1937 when this Coccid reduced the crop in the Kirovobad region by 20–60 per cent. The winter of 1936–37 had been less severe than usual, with an absolute minimum of –11.4°C. [11.48°F.], and a considerable number of mealybugs survived. The spring was unusually rainy and cold, but the summer was warm and dry, with a very hot period in July, August and September. The Coccid developed slowly in the first half of summer, but increased rapidly in abundance in August and September, and spread to vineyards over large areas. It completed four generations, instead of the usual three. The outbreak was evidently due to the marked rise in temperature combined with low precipitation. Atmospheric humidity is, however, of secondary importance in irrigated vineyards.

Laboratory tests have shown that *P. citri* can develop within a wide range of temperature. The eggs developed, though somewhat slowly, at 33°C. [91.4°F.] and were killed only at 35°C. [95°F.]. Oviposition took place at temperatures ranging from 15 to 38°C. [59–100.4°F.], the largest batches being obtained at 22–33°C. [71.6–91.4°F.].

[BEREZINA (V. M.).] **Березина (В. М.). Material for the Bioecology of the Cockchafer *Maladera holosericea* Scop.** [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 91-95, 1 graph, 10 refs. Leningrad, 1940.

In view of a record of damage to garden crops in Germany by adults of *Maladera holosericea*, Scop. [*R.A.E.*, A 26 194], an account is given of observations in 1935-37 on the habits of this Melolonthid in a mixed forest in the Province of Stalingrad and a pine forest in the Province of Voronezh, both having sandy soils. The larvae tended to congregate in soil having a pH content of 7.4. It appeared that the depth at which they occurred was related to the soil temperature of the locality, but changed little with variations in soil temperature or humidity during the summer. Observations in the mixed forest in 1936, when the weather there was unusually hot and dry and the temperature on the surface of the soil reached 63°C. [145.4°F.], showed that the percentages of larvae that occurred at depths of 0-4, 4-8 and 8-12 ins. were 16, 72 and 12, respectively, while in the pine forest, where the summer was moderate and the temperature of the soil at a depth of 4 ins. averaged 19.5°C. [67.1°F.] from May to September, the corresponding percentages were 84, 12 and 4, and larvae were found at the lowest depth only when the temperature there reached 20°C. [68°F.]. Pupae were present from June to September, and the peak of adult emergence occurred in the second half of August in the mixed forest and at the end of August and the beginning of September in the pine forest. The feeding habits of the adults were not ascertained, but they did not overwinter together with the larvae. The preference shown by the larvae for grasses would account for their abundance in the forests where considerable areas were grass-grown. It has not been proved that *M. holosericea* is injurious to forests, and an analysis by N. S. Greze of the stomach contents of 3 larvae taken in a forest near Kiev showed the presence of grass roots only.

[NOVOPOL'SKAYA (E.).] **Новопольская (Е.). New Data concerning the Biology of the Apple Sucker in the Crimea.** [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 96-98. Leningrad, 1940.

Descriptions are given of all stages of a Psyllid that attacks apple in the Crimea and differs considerably in morphology and biology from *Psylla mali*, Schm. Unlike *P. mali*, which hibernates in the egg stage, this Psyllid overwinters as an adult under the bark or in cracks on the trunks and in other sheltered places, the females having undeveloped ovaries. Activity is resumed when the mean temperature is about 8°C. [46.4°F.], usually in mid-March. If a cold spell follows, the adults return to their shelters. In the laboratory, they lived for 19-35 days and paired several times. Oviposition begins when the flower buds begin to burst and in 1934 it lasted from 22nd March to 25th April. The eggs are laid singly or in groups on the scales of the buds and on the lower surfaces of the leaves, less frequently on the flower stems and petals and occasionally on the upper surfaces of the leaves. In the laboratory, the maximum total number of eggs laid by a female was 130, and its ovaries contained 45 more. The egg stage lasted 17 and 9 days at mean temperatures of 9 and 18°C. [48.2 and 64.4°F.], respectively, and 21 days in the field at a mean temperature of 7.9°C. [46.2°F.] and a relative humidity of 48 per cent., the first nymphs

appearing when the flower buds began to separate. The nymphs usually concentrate at the base of the flower stems and in the axils of the leaf stems, weakening the tree by their sucking and causing the buds to drop. They moult five times and mature 20–25 days after hatching. There is only one generation a year, and the Psyllid has not been observed on any other plant but apple.

For control, it is recommended that a contact spray should be applied against the eggs when the buds are bursting, and against the nymphs when the inflorescences begin to separate.

[STARK (V. N.). **Старк (В. Н.). The Utilization of *Scolia* Species as a Control Measure against Cockchafer.** [In Russian.]—*Bull. Plant Prot.* 1940 no. 1–2 pp. 120–142, 2 figs., 2 pp. refs. Lenin-grad, 1940.

Damage to crops and pastures in the Russian Union by Lamellicorn larvae has been increasing for many years. The author reviews the control measures that have been adopted against these pests and concludes that, though none is completely satisfactory, one of the most promising is the use of parasites. Of the latter, the Scoliids have been particularly studied in Russia, and a review of investigations in different countries on their utilisation and a general account of their biology are given, based on the literature and recent Russian research [cf. *R.A.E.*, A 29 572].

The adults live for from 1 to 4 months, most of which time the females spend in the soil, searching for Lamellicorn larvae and ovipositing on them; when above ground they feed on the nectar of certain flowering plants, of which *Eryngium planum* and *Allium rotundum* appear to be especially attractive to *Scolia dejeani*, Linden, *S. hirta*, Schr., and *S. quadripunctata*, F., and also *Jasione montana* to *S. quadripunctata*. The Scoliids cover distances of several miles in search of food, remaining in places in which suitable plants occur only as long as these are in flower. They pair soon after they emerge from the cocoon, and the eggs mature in 7–12 days, during which time the females feed intensively. Before ovipositing, the female usually paralyses the host larva (though species of *Tiphia* do so incompletely), constructs a chamber in the soil into which the larva is placed and deposits an egg on it. In the laboratory, *S. dejeani*, *Campsomeris klugi*, Linden, and *C. sexmaculata*, F., paralysed larvae of all instars (except the first) of *Melolontha melolontha*, L., but oviposited only on those of the third. Usually, only one egg occurred on a host, though in the laboratory *Tiphia* spp. laid several, and eggs were not deposited on larvae already bearing the eggs of another female. The total number of eggs per female laid in the laboratory by individuals captured in the field (which had probably already deposited some of their eggs) ranged from 10 (in the case of *S. hirta*) to 93 (in the case of *S. quadripunctata*). Unfertilised females of *S. hirta* oviposited normally, the eggs giving rise to males only. The oviposition period extends over the greater part of the life of the female. The egg stage lasted from 1 to 7 days in the laboratory at temperatures fluctuating from 25 to 32°C. [77–89.6°F.]. At the optimum temperature of 25–30°C. [77–86°F.] and high humidity, the larval stage averaged 5–8 days for *Scolia* spp. and 9–11 for *Tiphia*. The full-fed larvae spin their cocoons in the chamber and then diapause for periods that last in different species

and in different individuals of the same species from a few days to 5-7 months. The pupal stage normally lasts only a few days, but may be prolonged to several weeks if the temperature is below or above the normal and humidity is low. The newly emerged adults remain in the cocoons for 3-5 days and make their way to the surface of the soil when the temperature at a depth of 8-14 ins., at which most of the cocoons occur, reaches 17-22°C. [62.6-71.6°F.] in the case of *Tiphia* and 23-25°C. [73.4-77°F.] in the case of *Scolia*. In 1938, Scoliid cocoons were found in the Province of Voronezh at a depth of only 4 ins., where the temperature sometimes falls below freezing point, which indicates a certain cold-resistance. The optimum temperatures for the adults are 20-25°C. [68-77°F.] for *T. femorata*, 25-30°C. for *S. hirta*, 27-35°C. [80.6-95°F.] for *S. dejeani* and 30-37°C. [86-98.6°F.] for *S. quadripunctata*. At temperatures above 38°C. [100.4°F.] the adults usually enter the soil.

The technique of breeding the Scoliids and their hosts in the laboratory is described at some length. In experiments with the species likely to be of most economic value [cf. *loc. cit.*], no alternative hosts were found for *C. sexmaculata*, *C. klugi* and *T. femorata*, but *S. quadripunctata* and *S. dejeani* were successfully bred on the larvae of *Liocola lugubris*, Hbst., and *Cetonia aurata*, L., and the latter also on those of *Oryctes nasicornis*, L. *L. lugubris* proved the most suitable host, as it was little attacked by fungous and bacterial diseases, which caused considerable mortality of the other two species. The adult beetles were kept in cages containing a 2-inch layer of sand and an 18-inch layer of leaf mould mixed with dry leaves; dry leaves were also placed on top of the cages. The beetles were fed on decaying fruits, molasses, honey, or fermenting wheat dough, and the larvae fed on decaying leaves, which were added periodically. The soil was kept moist. At 25°C. development was completed in 3-4 months. Oviposition occurred throughout the year, and third-instar larvae were used as hosts for the parasites.

The adult Scoliids were kept in cages containing soil and were fed on honey to which yeast or pollen was added; those that fed on this mixture lived almost three times as long as individuals given a saturated solution of sugar. Access to water is essential. With the exception of *T. femorata*, which fed also at 20°C., the Scoliids did not feed at temperatures below 25°C. For parasitism, the females were transferred to separate battery jars containing slightly compressed moist soil or sand; a drop of honey was placed on cardboard on the soil and a host larva transferred to a small pit made near one of the sides of the jar. Larvae on which eggs had been deposited were removed to small cells in flower pots or battery jars, which were covered and placed in a box of sand. Good results were also obtained with glass tumblers two-thirds full of sand and covered with a glass plate. When the Scoliid larvae became full-fed, cardboard covers were placed on the cells, as these facilitated the construction of the cocoons [cf. 21 13]. The latter were transferred to new cells after 3-4 days or kept together on filter paper or cotton-wool over water; 90-100 per cent. relative humidity of the air was essential. Some of the Scoliid eggs and young larvae were attacked in the laboratory by predacious mites, especially under crowded conditions.

The adult Scoliids survive transport provided that it does not last longer than a fortnight, and they are allowed sufficient space in the container. The method of packing them is described.

[MEYER (N. F.).] Мейер (Н. Ф.). **The theoretical Basis of the biological Control Method against injurious Insects.** [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 143-152, 3 figs., 19 refs. Leningrad, 1940.

The part played by predators and parasites in regulating the abundance of insect pests in nature is discussed and illustrated by instances cited from the literature, and notes on hyperparasitism and immunity in individuals of a host are given [cf. *R.A.E.*, A 13 543; 14 195]. The author does not agree with the theory of a mobile equilibrium according to which a parasite population always fluctuates with that of its host, since it does not apply in the case of parasites or predators that attack several hosts, some insects are parasitised on certain plants and not on others, and environmental factors such as temperature have an unequal effect on host and parasite. Work in the Russian Union on the establishment of predators and parasites is reviewed, and it is pointed out that the problem of using fungi and bacteria for the control of insect pests has not yet been satisfactorily solved. It is suggested that the production of conditions under which the pests are likely to succumb to diseases might be substituted for the direct dissemination of disease agents among them. Fungous diseases among soil pests may follow a change in the acidity of the soil effected by suitable manures [cf. 30 65].

[MEYER (N. F.) & TYUMENEVA (V. A.).] Мейер (Н. Ф.) и Тюменева (В. А.). **The Influence of changeable Temperatures upon the Dates of the Development, Fecundity and Relation of the Sexes of the *Trichogramma*.** [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 153-160, 6 refs. Leningrad, 1940.

The investigations described were carried out at Slavyansk, northern Caucasus, with the Azov-Black-Sea, Slavyansk cabbage-white, Romnui and Astrakhan races of *Trichogramma evanescens*, Westw. [cf. *R.A.E.*, A 27 589] reared on eggs of *Sitotroga cerealella*, Ol., and *Plusia gamma*, L. Host eggs and parasites were kept outdoors in glass tubes from the beginning of April 1938, or, in the case of the Astrakhan race, from 10th May; parasitised eggs were removed daily to other tubes, where they were kept until the parasites emerged. The temperature at Slavyansk varies considerably from day to day, but the relative humidity of the air near the soil surface is more or less constant. Temperature was, therefore, the chief factor influencing the increase of the parasites. The Astrakhan race produced 13 generations by 4th December, and the other races 14 by mid-December. It is concluded that the duration of development from egg to adult depended chiefly on the mean temperature, though it was also affected by minimum temperatures [cf. 29 581]. A considerable fall in the minimum temperature retarded development, but did not stop it even if the drop was down to -5°C . [23°F]. At mean temperatures of about 20°C . [68°F], development of the cabbage-white race required 15 and 19 days when the corresponding minimum temperatures were 6.8°C . [44.24°F] and 1.5°C . [34.7°F]. The effect of maximum temperatures was less; thus, in the case of the cabbage-white race, development was completed in 10 days at mean temperatures of 24.7 , 25.2 and 25.5°C . [76.46 , 77.36 and 77.9°F], though the maximum temperatures were 34.4 , 36.3 and 38.4°C . [93.92 , 97.34 and 101.12°F], respectively. The

duration of individual generations to the end of the life of the last adults was very protracted, lasting 98, 107–108, 84–108 and 82–85 days in autumn for the cabbage-white, Azov-Black-Sea, Romnui and Astrakhan races, respectively. Host eggs parasitised on the same day gave rise to adult parasites on different dates, which resulted in a protracted oviposition period for the generation and reduced the rate of increase in the numbers of the parasite. At constant temperatures, however, adult emergence was completed within 1–2 days. The females laid more eggs in eggs of *Plusia* than in those of *Sitotroga*, while the total number of eggs parasitised per female and the duration of development in them were about the same in the case of each host, so that the population increased more rapidly when eggs of *Plusia* were used. Females of the Romnui race preferred the eggs of *Sitotroga*, but the other three races preferred those of *Plusia*. Females represented only 56.6–63.3 per cent. of the adults obtained when the temperature fluctuated, as compared with 70–78 per cent. at constant temperatures and humidity, and in all except the Romnui race, the proportion that oviposited was greater at constant temperatures. It is concluded that each race of *T. evanescens* should be bred at the constant temperature and humidity optimum for it.

[SHCHEPETIL'NIKOVA (V. A.). Щепетильникова (В. А.). The Ecology of the Azov-Black-Sea Race of *Trichogramma evanescens* Westw. [In Russian.].—Bull. Plant Prot. 1940 no. 1–2 pp. 161–165, 18 refs. Leningrad, 1940.]

Observations were made on the effect of fluctuating temperatures on the development of the Azov-Black-Sea race of *Trichogramma evanescens*, Westw., in Leningrad in 1937–38. For this purpose, females of the cabbage Noctuid [*Mamestra brassicae*, L.], which is the chief host of the parasite, were allowed to oviposit on cabbage plants in the open, and the resulting egg-batches were covered for 30–60 minutes with test tubes containing newly emerged parasites that had been reared in the laboratory in the eggs of *Sitotroga cerealella*, Ol. In all, 59 egg-batches comprising 5,183 eggs were parasitised. When the adults emerged, fresh egg-batches of the Noctuid were placed on neighbouring cabbage plants for them to oviposit in. During the oviposition period of the Noctuid, which lasted until 1st August, three generations of the parasite were produced, the adults of the third emerging on 8th August. Two additional generations were obtained from eggs of the Noctuid that had been deposited in the laboratory and were fixed to the lower surfaces of the leaves of cabbages outdoors. During the period of observations, the mean relative humidity was 76–82 per cent., almost the same as that at which mass rearing of *T. evanescens* is usually carried out, but the temperature ranged more widely and was the chief factor affecting the development of the parasite, which lasted about 35, 21 and 14 days at means of 16, 20 and 24°C. [60.8, 68 and 75.2°F.]. The duration and character of the flight of the adults, on the other hand, was influenced not by mean temperatures, but probably by such factors as the extremes of temperature and the frequency and duration of the fluctuations; thus, at almost identical mean temperatures, the flight in two instances lasted 11 and 14 days in 1937, and 6 and 4 days in 1938.

For comparison, the development of this race of *T. evanescens* in eggs of *M. brassicae* was observed in the laboratory at constant temperatures approaching the averages in the field and a relative humidity

of 75–80 per cent., and the results are shown in a table. It is concluded that fluctuating temperatures prolong the period of development by about 22 per cent. in comparison with constant temperatures, and cause the adults to emerge over longer periods.

[GORETZKAYA (I. N.).] Горецкая (И. Н.). The Results of the Use of the *Trichogramma* of the Azerbaidjan Race as a Control Measure against the American Cotton Boll Worm on Cotton Plants in the Azerbaidjan SSR. [In Russian.]—*Bull. Plant Prot.* 1940 no. 1–2 pp. 166–172. Leningrad, 1940.

The Azerbaijan race of *Trichogramma evanescens*, Westw., was first reared in 1936 from eggs of the Noctuid, *Apopstes spectrum*, Esp., collected near Kirovabad, and in field experiments carried out there in 1936–38, in which large numbers of parasites were liberated against eggs of *Heliothis armigera*, Hb. (*Chloridea obsoleta*, F.) on cotton, it proved more effective than the Azov-Black-Sea race and the Central Asiatic form [subsequently described as *T. turkestanica*, Meier]. It was found that in the climate of Kirovabad, which is intermediate between the dry subtropical and temperate climate, development of the Azerbaijan race continued throughout the summer, provided that eggs of *H. armigera* were sufficiently numerous. None of the three forms, however, survived even for a season in the Mugan steppe, where the climate is of the dry subtropical type with sharp fluctuations in temperature and humidity. The natural increase of the Azerbaijan race near Kirovabad is restricted by unfavourable weather in autumn and winter, and the lack of sufficient numbers of winter hosts. Observations in 1937–38 showed that the percentage parasitism of eggs of *A. spectrum* in May did not exceed 5, while that of eggs of *Pieris rapae*, L., *H. (C.) dipsacea*, L., and *Plusia (Phytometra) gamma*, L., in April was less than 1; no parasitism was found in eggs of *Pieris brassicae*, L., or *Tortrix (Cacoecia) strigana*, Hb. The eggs of *H. armigera* on various crops were parasitised from mid-July to the end of August.

It has been shown that the optimum temperature for these three forms is 25–27°C. [77–80.6°F.] and the optimum percentage relative humidity 64–66 for the Azerbaijan race, 70–75 for the Azov-Black-Sea race and 73–75 for *T. turkestanica*. Observations carried out in June–September 1938 on the development of the three forms in the field after the release of adults on sample plants artificially infested with eggs of *H. armigera* or *Sitotroga cerealella*, Ol., showed that the percentage of females in the following generation was considerably reduced when climatic conditions differed from the optimum. The percentage parasitism by the Azerbaijan race ranged from 16 to 62 and was also reduced when either temperature or humidity deviated from the optimum. The adult parasites did not spread by unaided flight for more than about 30 ft. from the point of release, but covered a distance of 100 ft. in the direction of a wind with a velocity of not more than 6.7 miles per hour.

When the Azerbaijan race was released in cotton fields at the rate of a total of 200,000 per acre, the most satisfactory method was to liberate 5 batches of about 40,000 each at intervals of 3 days. Under these conditions, the percentage parasitism of *H. armigera* was maintained at an approximately even level of 40–48 throughout the period of application. When three batches of about 166,000 were released at intervals of 5 days, parasitism was high during the first 3 days after each release

but then decreased sharply. If applied against each generation of the moth and begun as soon as the first eggs appear, the 3-day system of release should reduce the numbers of larvae of *H. armigera* by 45 per cent. or more. The parasites should be liberated in the evening at 40 separate points per acre, to secure an even distribution. Releasing them against *H. armigera* on *Hibiscus esculentus*, which is frequently grown as a trap crop for the moth in Azerbaijan, was ineffective, since the spines and sticky exudation on the capsules killed the adult parasites before they could reach the eggs of the moth. The percentage parasitism did not exceed 18.2.

[BUGDANOV (G. B.).] Бугданов (Г. Б.). **Testing *Trichogramma* as a Control Measure against *Cydia pomonella* in the Conditions of the Foot-hill Zone of the northern Caucasus in 1939.** [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 173-178, 1 graph, 14 refs. Leningrad, 1940.

An account is given of investigations in 1939 in which the Pyatigorsk race of *Trichogramma* was released against the codling moth [*Cydia pomonella*, L.] on apple in the region of Alagir, where this pest has two complete generations a year. As a result of prevailing wet weather, the emergence of the adult moths of both generations was retarded by 8-10 days and the oviposition period lasted 42 days. The moths of the overwintered generation began to emerge at the end of May, and the parasites were released against the first-generation eggs on 8th and 15th June (at the peak and towards the end of mass oviposition). Two packets of 1,500 parasitised eggs of *Sitotroga cerealella*, Ol., were placed on each tree on the first date, and 2 packets of 500 on the second. Four liberations were made against the second-generation eggs between 22nd July and 8th August, a total of 5,000 parasitised eggs being placed on each tree. Examination of fallen fruits and of those on the trees at harvest showed that the percentages infested were 32.7 and 17.4 in the treated orchard and 76.5 and 53.6 in the controls. The percentage infestation of fallen apples did not exceed 30 during the period in which the parasites were being liberated, but rose to 44.5 afterwards, which indicated that the parasite was present in insufficient numbers and should have been released over a longer period. Rainfall was unfavourable to the parasite, since hatching was incomplete in packets that became wet, and the adults were killed by rain. It is concluded that in general the standard rate of 4,000 parasites per tree is sufficient, but it is better to release them in a succession of smaller batches over a longer period to ensure their presence in sufficient numbers throughout the time that the moths are ovipositing and to avoid superparasitism.

[SHAPIRO (I. D.) & KUPERMAN (Ya. M.).] Шапиро (И. Д.) и Куперман (Я. М.). **A Test of the Adaptability of the *Trichogramma* as a Control Measure against the Cotton Boll Worm on the Culture of Tomatoes in Azerbaidjan.** [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 179-182, 3 graphs. Leningrad, 1940.

In view of the very serious damage caused to tomatoes in Azerbaijan by *Heliothis armigera*, Hb. (*Chloridea obsoleta*, F.), experiments on the utilisation against it of the Azov-Black-Sea race of *Trichogramma* [*evanescens*, Westw.] were carried out in 1938. Ten liberations, for

each of which 100,000 parasitised eggs were used per acre, were made at intervals of 5 days beginning in mid-July. The eggs were set out in tomato fields at 20 different points per acre, on reeds about 15 ins. long cut obliquely an inch above a node, each reed thus representing a shallow container on a long stalk. Observations at regular intervals on sample plants in a treated and an untreated plot showed that, though the moth had laid considerably more eggs in the former, the injury caused by the larvae to the buds and setting fruits was 40.9 per cent. less than in the control. Fewer fruits dropped in the treated plot and the percentage infested was 45.4, as compared with 63.7 in the control. Of the harvested tomatoes, only 17 per cent. were damaged, as compared with 30.3 per cent. in the control. The difference between these figures would probably have been still greater had not the prevailing wind carried considerable numbers of the parasite to the control plot. The effectiveness of the parasite became particularly evident from about 10th August.

[SIDOROVNINA (E. P.).] Сидоровнина (Е. П.). On the Hibernation of the Egg-parasite of the Bug (*Eurygaster integriceps* Osh.), *Microphanurus semistriatus* Nees. [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 183-184. Leningrad, 1940.

With a view to breeding *Microphanurus semistriatus*, Nees, in the laboratory for release against the Pentatomid, *Eurygaster integriceps*, Put. [on cereals], a search was made in the autumn of 1939 in the Province of Ordzhonikidze (northern Caucasus) for the hibernation quarters of this Scelionid. Adults were repeatedly found from October to mid-December under the bark on the lower part of the trunks of fruit trees [cf. *R.A.E.*, A 29 575], and on warm sunny days they made their ways to the surface of the bark where they were observed resting or moving actively. In November, females collected from the bark readily parasitised the eggs of *E. integriceps* in the laboratory, and 4 generations were obtained by 15th December, the life-cycle being completed in an average of 11 days at 28°C. [82.4°F.] and 75-90 per cent. relative humidity. Males and females were produced in equal numbers; the females were each given 15 host eggs, and the percentage parasitism was 80-98. Eggs fixed on muslin were parasitised most readily. By December, 7,000 parasitised eggs of the bug were obtained.

[BOGDARINA (A. A.).] Богдарина (А. А.). The Influence of Water Supply on the Shedding of Apple Leaves during Spraying with Mineral Oil Emulsions. [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 185-191, 1 graph, 14 refs. Leningrad, 1940.

A detailed account is given of laboratory experiments in Leningrad in 1934 in which it was found that the percentages of the leaves of apple seedlings that fell following the application of oil emulsions varied inversely with the moisture content of the soil in which they were grown and with that of the leaves themselves, and of field experiments in the Crimea in 1935 showing that oil emulsions caused fewer leaves of apple to drop on irrigated trees than on unwatered ones [cf. *R.A.E.*, A 29 652]. Spraying the larger branches with 2 per cent. emulsions of three mineral oils at 25°C. [77°F.] and 52 per cent. relative humidity caused shedding of the leaves, which, however, was invariably less in the case of irrigated trees.

[SHIPINOV (N. A.).] **Шипинов (Н. А.). Sorbtion of HCN on Soils during their Fumigation with Cyanides.** [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 192-199, 7 graphs, 8 refs. Leningrad, 1940.

The problem of adsorption of the fumigant is of importance in most types of fumigation, but is particularly so in the fumigation of soil, in which the surface area of the particles is very large in comparison with the amount of air between them. Laboratory and field investigations were therefore carried out in Leningrad in 1936 on the adsorption of hydrocyanic acid gas in soil, so as to facilitate the calculation of the concentrations to be applied. Liquid HCN (98 per cent.) was used for the experiments. The laboratory tests were made on samples of a light clay, black soil and forest sand, all taken at a depth of 6-8 ins., passed through a sieve and dried. Isotherms of adsorption at 20°C. [68°F.] were found for all three types of soil, and also at 10 and 0°C. [50 and 32°F.] for the black soil, and a formula is evolved to show the amounts adsorbed and free gas in soils of different types containing different concentrations of HCN.

In the field experiments, the amount of free HCN in the soil proved to be very low, constituting only 0.5 per cent. of the total amount present. This indicated that the bulk was in the adsorbed phase. As the fumigant gradually evaporated, the adsorbed gas was released, which retarded the decrease in concentration. Adsorption also retarded the diffusion of the fumigant in the soil, and thus limited its radius of action. The general tendency was for the concentration of free gas to increase at first and then to drop, but the process was comparatively slow. Complete decomposition of HCN in the soil apparently required at least 7 days, but diffusion of the gas took place only for the first 2-3 days, while evaporation at the point of release was still intense. The commonly accepted view that the slowly decomposing cyanides are more suitable for soil fumigation than those that release the gas rapidly therefore requires confirmation.

[FILATOV (K. N.).] **Филатов (К. Н.). The Decrease of the Norm of Sodium Arsenite as a Control Measure against the Siberian Grasshopper (*Gomphocerus sibiricus* Lin.).** [In Russian.]—*Bull. Plant Prot.* 1940 no. 1-2 pp. 202-203. Leningrad, 1940.

A brief account is given of field experiments carried out in the summer of 1937 in the Province of Chelyabinsk, western Siberia, with baits of moist or dry chaff or horse dung mixed with sodium arsenite containing 52.7 per cent. arsenic trioxide against *Aeropus* (*Gomphocerus*) *sibiricus*, L. The results were estimated by sweeping, by counting the dead grasshoppers on the treated plots and observing the mortality among individuals taken in treated plots and kept for several days in the insectary. It was found that the bait was highly effective even against the adults when it contained only 2 per cent. sodium arsenite. Baits of moist and dry dung containing this amount of poison killed 83.4 and 75.5 per cent. of the grasshoppers in the field and 85.5 and 90.5 per cent. of those kept under observation in the insectary. The dry bait, however, is possibly less effective than these figures indicate, as it became moist after application owing to wet weather. The baits made with moist or dry chaff were much less effective, but the quality of the chaff was unsatisfactory.

ENGLISH (L. L.) & TURNIPSEED (G. F.). **The Influence of Temperature and Season on the Citrus Red Mite (*Paratetranychus citri*)**.—*J. agric. Res.* **62** no. 2 pp. 65-77, 11 figs., 6 refs. Washington, D.C., 1941.

The following is substantially the authors' summary of this account of experiments, carried out over several years, on the relations between temperature and the development of *Paratetranychus citri*, McG., on *Citrus*, and on the variation of development with the season. Several phases of the life-history of the mite were found to be mathematically related to the average temperature computed from thermograph charts. The length of the incubation period, the time for development from egg to adult and the time for development from egg to egg were found to be functions of average temperature, which could be approximated by the exponential equation $y = e - ae^{-bx}$, where y is the period of time in days and x the average temperature in degrees Fahrenheit. The duration of adult life was found to be a linear function of average temperature, conforming to the equation $y = -ax + b$, where y is the time in days and x is the average temperature. The average incubation period and the time for development from egg to adult formed U-shaped curves when plotted against the months from January to December. The adult life span and the total life span of mites also approximated U-shaped curves when plotted against the months of the year. The adult life span of males was found to be shorter than that of females.

The population of the mite declines in hot and increases in cool weather. The early spring months apparently afford optimum conditions. Although the temperatures at this season do not induce the most rapid development, other factors, such as the long life of the adults and the high rate of egg production, aid in promoting the maximum population.

JOHNSON (J. P.). *Cyclocephala (Ochrosidia) borealis* in Connecticut.—*J. agric. Res.* **62** no. 2 pp. 79-86, 2 figs., 11 refs. Washington, D.C., 1941.

An account is given of the bionomics of *Cyclocephala borealis*, Arr., in Connecticut and experiments on its control [*R.A.E.*, A **28** 644], and all stages are described. It is stated that the range of this Dynastid extends as far west as California [*cf. loc. cit.*], and that it was first recorded in Connecticut in 1931 [**20** 701]. Between 1936 and 1939, it was found in a number of places in the south-western part of the State, and it has injured or destroyed many acres of fine turf in lawns and golf-courses. Of 1,000 larvae examined, 25 were found to be parasitised by an unidentified species of *Tiphia*.

HENDERSON (C. F.). **Apparatus and Technique for the Study of the Egg Parasites of the Beet Leafhopper**.—*Circ. U. S. Dep. Agric.* no. 593, 18 pp., 8 figs. Washington, D.C., 1941.

In studying the life-history and field activities of egg parasites of *Eutettix tenellus*, Baker, in Idaho, owing to the extremely small size of these parasites and their occurrence in the host eggs under the epidermis of the plant, it was necessary to develop special apparatus, the construction and use of which are described, for rearing the field material in the laboratory.

The egg parasites used in testing the various pieces of equipment were the Trichogrammatids, *Aphelinoidea plutella*, Gir., and *Abbellia subflava*, Gir., which are widely distributed in Russian-thistle [*Salsola*] breeding areas and in beet fields, and the Mymarids, *Polynema eutettixi*, Gir., and *Anagrus giraulti*, Crwf., which seem to be more or less confined to beet fields. Rearing cabinets having constant conditions of light and temperature proved useful in determining approximate parasite populations in a given unit of host plant material, seasonal fluctuations in parasite populations, which are indicative of successive broods, winter mortality, synchronisation with the host, spring emergence, and other phenomena being studied in connection with the bionomics of the various parasites. The cabinets were tested with temperatures of 80 and 85°F. and with light intensities of from 4.8 to 47.6 foot-candles for the rearing of the four parasites. In general no great differences were observed in the rearings made under various conditions. The usual type of rearing cage (a box with collecting vials inserted in the end) proved inadequate for the rearing of the Trichogrammatids; cages consisting of a cardboard cylinder, with a wire-screen partition that holds the plant material away from one side, so that a shaft of light extends for the full length of the tube and the parasites have a clear path to the light, proved much more efficient for these two species.

Weight and volume of the food-plant and food-plant area are used as quantitative units in the study of the egg parasites. A volumetric tank proved efficient for determining the volume of food-plant material. In work with samples that have to be kept for about three weeks before the numbers of parasites can be accurately determined, it was desired to know the minimum number of cages in a sample necessary for a given degree of accuracy. This minimum number has been determined in a large number of collections and should serve as an index for future collections made under similar conditions. An analysis of all collections indicated that 15 cages would usually suffice for the accuracy desired, and as it was assumed that the same variance would occur in subsequent collections taken on the same plants in like manner, this number was ordinarily used.

BARBER (H. G.). **A new Species of *Tibraca*, injurious to Rice in Ecuador (Hemiptera-Heteroptera : Pentatomidae).**—*Proc. ent. Soc. Wash.* **43** no. 5 pp. 110–111, 1 fig. Washington, D.C., 1941.

Tibraca simillima, sp. n., is described from adults of both sexes found injuring rice in Ecuador, and characters distinguishing it from *T. limbiventris*, Stål, which it closely resembles, are given. *T. limbiventris* was described from Brazil, and the author has also received specimens taken on rice in Dutch Guiana.

Proceedings of the Anti-Locust Conference held at New Delhi on the 21st October 1941.—ii+22 pp. Simla, 1941.

This Conference of representatives of the Central Government of India and of the Provinces and States discussed the present outbreak of the desert locust [*Schistocerca gregaria*, Forsk.] in India and the organisation required for its control. It was agreed that there should be a maximum amount of co-ordination among various authorities engaged in control, but that each Province or State should continue

to be responsible for the actual control work within its territory. The Conference were unable to come to an agreement on the question of control in the desert areas; the Central Government were asked to examine this problem and to continue to supply information and advice to the Provinces and States. Driving locust hoppers into trenches was recommended as the most practicable method of destruction.

Pinhole or Powder-post Damage? How to distinguish two common Types of Insect Attack in Hardwoods.—*Leaf. For. Prod. Res.* no. 17, 4 pp., 7 figs., 5 refs. London, 1941

The types of damage caused by *Lyctus* and pinhole borers [Platypids and Scolytids], which differ greatly in importance, are described, so that they may be easily distinguished by those responsible for the selection and inspection of timbers. The mechanical properties of timber showing pinhole-borer damage is not affected unless the pinholes are very numerous; seasoned lumber, sapwood as well as heartwood, containing them can be used with safety in the knowledge that the damage will not increase as pinhole borers cannot live in seasoned wood. *Lyctus* on the other hand makes its appearance after conversion and during seasoning. It will infest partly manufactured articles and continue to live in the finished products, reducing sapwood to a flour-like powder. Timber showing evidence of *Lyctus* attack should be discarded and under no circumstances put into consumption unless previously sterilised by heat treatment from a kiln [cf. *R.A.E.*, A 25 669]. A similar type of damage is caused by Bostrychid powder-post beetles in the sapwood of many tropical hardwoods and softwoods. Although these insects may not breed in the timbers after their arrival in England, obviously infested wood should not be used without sterilisation treatment.

PAPERS NOTICED BY TITLE ONLY.

- FERRIS (G. F.). **Atlas of the Scale Insects of North America. Series II & III.**—Demy 4to., [277 & 240] pp., planographed, [107 & 96] pls. (Nos. SII-1a, 2a, 137-268 & SIII-2b, 269-384). Stanford Univ. Pr., Calif.; London, H. Milford, 1938 & 1941. [Cf. *R.A.E.*, A 25 595.]
- WOKE (P. A.). **Structure and Development of the Alimentary Canal of the Southern Armyworm Larva** [*Laphygma (Prodenia) eridania*, Cram.].—*Tech. Bull. U. S. Dep. Agric.* no. 762, 29 pp., 9 figs., 32 refs. Washington, D.C., 1941.
- DORST (H. E.). **Double-hill Planting of Tomato Plants minimizes Losses from Curly-top Disease** [transmitted by *Eutettix tenellus*, Bak., in Utah]. **Cheesecloth Covers also effective Means of protecting Plants.**—*Farm & Home Sci.* 2 no. 1 p. 3, 2 figs. Logan, Utah, 1941. [Cf. *R.A.E.*, A 29 631-632.]
- TWINN (C. R.). **A summary Statement concerning some of the more important Insect Pests in Canada in 1940.**—*Rep. ent. Soc. Ont.* 71 (1940) pp. 53-61. Toronto, 1941.
- ПАЙКИН (D. M.). **Пайкин (Д. М.). The Use of a Film and Polychlorides** [in trap ditches] **as a Control Measure against the Beet Weevil** [*Cleonus punctiventris*, Germ., in Ukraine]. [In Russian].—*Bull. Plant Prot.* 1940 no. 1-2 pp. 47-52, 1 graph, 7 refs. Leningrad, 1940. [Cf. *R.A.E.*, A 30 68.]

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- NEW YORK STATE MUSEUM (ALBANY, N.Y.): Bulletin: 26 & 57 (1899-1902).
- ONTARIO ENTOMOLOGICAL SOCIETY REPORT (TORONTO): 9th (1878).
- ORMEROD (E. A.). OBSERVATIONS OF INJURIOUS INSECTS AND COMMON FARM
PESTS DURING THE YEARS 1877 & 1878 (London, 1878-79).
- PHILIPPINE AGRICULTURIST AND FORESTER (MANILA):
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- PHILIPPINE JOURNAL OF SCIENCE (MANILA): Vol I (1906) No. 10.
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- UNITED STATES DEPARTMENT OF AGRICULTURE (WASHINGTON, D.C.):
Howard (L. O.). Report of the Entomologist, 1895.
- VIRGINIA: AGRICULTURAL EXPERIMENT STATION (BLACKSBURG, Va.):
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1896-97 (Richmond, Va, 1897).
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1905).
- WEST INDIAN BULLETIN (BARBADOS): Title-page & Index to Vol. IV.
- ZEITSCHRIFT FÜR DAS LANDWIRTSCHAFTLICHE VERSUCHSWESEN IN ÖSTERREICH
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